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FOR THE

PROMOTION OF THE MECHANIC ARTS.

JANUARY, 1851.

CIVIL ENGINEERING.

Extracts from the Fifth Annual Report of the Superintendent of the Vermont Central Railroad Company, October 31st, 1850.

GENTLEMEN:—As anticipated in my last annual Report, the road was opened into the town of Burlington in all the year 1849. Regular passenger and freight trains commenced running to Middlesex on the 30th day of August, distance 84 miles from Windsor; to Waterbury on the 29th day of September, distance 89 miles; and to Burlington on the 31st day of December, distance 115 miles.

The track has been extended during the present month to the wharf on Lake Champlain at Burlington, making the total length of the road 117 miles, from the north end of the Sullivan Railroad Bridge over Connecticut River in Windsor, to Lake Champlain at Burlington, including the branch of one and a half miles in length into Montpelier.

A large portion of the track was either laid at final grade, or has since been raised to grade. About 30 miles of track yet requires raising from six inches to one foot, and 10 miles from one to two feet, to bring it to final grade. When this is done, the track throughout the whole length of the road will be in perfect running order. The material used for grading is of a superior quality. At a few points, however, it is rather too fine, but may hereafter be coated over with a coarser material at a moderate expense if deemed advisable, (and I think it will be,) to prevent the dust from arising in dry weather, while the trains are passing. Most of the track, yet requiring to be raised to grade, lies between Montpelier and Burlington, and was laid in mid-winter, when the ground was frozen so hard and deep as to prevent its being laid at grade. Besides this, the time set for opening

the road to Burlington was so limited that it could not have all been graded up, had the weather permitted.

All the track might have been raised and surfaced off at final grade previous to this time, had the company have had a sufficient number of engines and gravel cars for that purpose. It has frequently occurred during the past year, that not more than one gravel train could be used at a time for want of motive power, when it required at least four constantly in use to have finished the grading as it might and should have been done.

The embankments generally, where they are or may hereafter be exposed to the action of the water in the rivers during high freshets, have been protected with riprapping of stone taken from the rock excavations on the line.

All the river turnings have stood the test of the spring and summer freshets remarkably well, except the one in Middlesex, and the one in Waterbury, neither of which were finished at the time of the great freshet on the 19th of July last, which caused such great destruction of property throughout the country.

The damage sustained on these two points was not so great as at first anticipated. Including these, the damage done to the whole road, by the three high freshets which have occurred since the middle of July last, will not exceed $35,000.

A thorough examination of all the points affected by the freshet of July 19th, and an estimate of the probable cost of repairing the same, was made immediately after the freshet, which amounted to a fraction less than $30,000.

The repairs of damages have since progressed with as great rapidity as the means within the possession of the Company would allow. Most of them have already been completed, and the remainder will be finished in all the next month.

No doubt is entertained of the future stability of the road, when the repairs are completed, and the new channel, cut for turning Winooski river in Middlesex, is made of a sufficient width, and the embankments and masonry, at that and other exposed points, properly secured by riprapping.

The wooden superstructure of the bridges, built under the contract with S. F. Belknap, deceased, (which did not include covering,) are being covered by the Company, to protect them from the weather. Most of them are now finished, and the remainder of them will be done during the present season.

A number of the excavations on the Burlington end of the road require sloping and ditching, especially the deep cut in the town of Burlington, which was left by the contractors as soon as a space of sufficient width to lay the track was made. The earth to be taken from these excavations is required upon the embankments to bring them to their proper width and height.

At six different points the track was temporarily laid around and over rock excavations, to facilitate the early opening of the road to Burlington. The passenger and freight trains passed regularly over these points from the opening of the road until August last, when the whole were completed, and the track permanently laid. By this means the road was opened to

Burlington from four to six months earlier than it otherwise could have been.

Two regular passenger trains, and one freight, have been running most of the time during the year ending June 30th; also from one to three gravel trains, and an occasional train for hauling and distributing materials for the construction of the road, and for wood.

Depot Buildings of a uniform size and finish have been erected at most of the stations on the road; also water houses, wood sheds, &c.

On the 30th of June last the Company had upon the road twelve locomotive steam engines of the first class, and three of a small size, second hand;* ten eight-wheel passenger cars, two eight-wheel postoffice, express, and baggage cars, one eight-wheel baggage car, (since altered to postoffice and express,) ninety-three eight-wheel merchandize box cars, twenty-nine eight-wheel platform stake cars, eighty-eight four-wheel gravel cars, fourteen second hand gravel cars, four four-wheel iron cars, fifteen hand cars, one large snow plough, six small snow ploughs, and twelve cow catchers.†

In my last annual report I stated that, "It has been thought to be economical and advisable to undertake the building of a limited number of baggage and freight cars at the repair shops in Northfield."

Materials were partially purchased for the construction of two postoffice, express, and baggage cars, and for twenty-five eight-wheel merchandize box cars. One of the postoffice, express, and baggage cars, and three of the merchandize cars, were completed and put upon the road previous to the 30th of June last, at a cost less than the price paid by the Company to other car builders for cars of like description. Since that time seven merchandize box cars, and one postoffice, express, and baggage car, have been built and placed upon the road, and ten more will soon be completed. Six hand cars were also built by the Company and used upon the road prior to June 30th.

A greater number of merchandize cars would have been constructed during the past year, but for the large and increasing amount of work necessary to be done at the repair shops for finishing the construction of the road to Burlington, and for the Vermont and Canada Road.

No doubt is entertained but that the Company can build their own merchandize cars better, and for a less cost, than they can be purchased of other car builders. It not unfrequently occurs, when repairs are light, that the repair hands are profitably employed in the construction of new cars, by thus keeping them constantly in work, which could not otherwise be done.

No additional number of hands has been employed *expressly* for constructing new cars. Those that have been built, have been done by the surplus labor of the regular repair hands.

Four first class locomotive engines have been purchased and placed upon the road within the present month, and twenty eight-wheel merchandize cars. Four additional engines will be required the coming spring.

Contracts have been made on favorable terms for the Company for one hundred and sixty eight-wheel merchandize cars, to be delivered at the rate of six per week, twenty of which have already been delivered.

This number, together with those being built at the repair shops of the

* Cost from schedule, $102,811·14. † Cost from schedule, $129,795.

Company, in addition to the present stock, will probably be sufficient for the ordinary business of the road the coming season, provided the Ogdensburg company furnish cars for all through business from their road.

BUSINESS OF THE ROAD.

From June 26, 1848, (when the Road was first opened from W. R. Junction to Bethel,) to June 30, 1850.

INCOME.

From Passengers: Gross earnings after deducting the proportion paid Roads below,	$159,066·96	
From Freight: Gross earnings, do. do.	139,031·08	
From Express: Gross do. do.	2,266·54	
From U. S. Mails: Gross do. do.	5,563·82	
From Winooski Turnpike,	4,976·00	
From Miscellaneous,	1,089·34	
		$311,993·74

EXPENSES.

For Repairs of Road,	14,121.00	
For Fuel, Oil, and Waste,	22,809·80	
For Repairs of Engines,	13,873·27	
For Repairs of Passenger Cars,	9,135·95	
For Repairs of Freight Cars,	7,488·46	
For Salaries, Wages, &c., Passenger Department,	16,817·88	
For do. do. &c., Freight Department,	23,689·66	
For Miscellaneous Expenses,	6,504·65	
For Gratuities and Damages,	832·39	
For Insurance,	412·00	
For Switchmen and Watchmen,	4,576·41	
		120,261·47
Total nett Earnings		$191,732·27

There has been charged to repairs of road in the above amount, during the year ending June 30 (previous to which time nothing has been charged to that account,) one section hand and two helpers for each seven miles of track, as fast as the same was laid, and the road opened for business. This number is required to keep the track in proper running order when it is finished, and has therefore been charged accordingly since the road was opened, although in an unfinished state. This, however, is not the usual practice on other roads, as all repairs of track are charged to construction account until the whole is finally finished off at grade. The road being new, no iron or ties were required for repairs, and no repairs on bridges, station houses, fences &c.

All work done upon the road, other than the above, where the track was laid, was for sloping and finishing the sides of the excavations, digging ditches, hauling gravel, raising and surfacing track to final grade, widening the embankments, covering bridges, building fences, &c. &c, the cost of all which has properly been charged to construction account.

The business of the road has been steadily on the increase. The nett receipts, after paying the proportions of the roads below, were for the month of June over $21,000, July over 12,000, (business interrupted by freshet half the month,) August over $25,000, and September over $30,000.

It is confidently believed, that upon the final completion of the Vermont and Canada Road to a connexion with the Ogdensburgh Road by a bridge at Rouse's Point, the nett receipts of the road will at once be swelled far beyond the present amount.

The Company have not had motive power and cars sufficient to do the

business offered during the past month. Notwithstanding a considerable number of cars were borrowed of the lower roads, the depôts on the line are mostly filled to their utmost capacity with goods waiting for shipment.

June 30, 1850.

Stock on hand at the Repair Shops in Northfield, and Fuel, Oil, and Waste, $30,793·22

Whole number of Passengers carried in the Cars,					182,964½
"	"	"	"	one mile,	3,319,535
"	"	Tons of Freight	"	in the Cars,	61,968
"	"	"	"	one mile,	2,294,981

The above includes the number of passengers and tons of merchandize carried one mile on the Central Road only, and not the number carried to and from the roads below in Central cars.

Number of Miles run by Engines and Trains during the year ending June 30, 1850.

Passenger Trains,	90,890
Freight,	62,370
Gravel and other Trains,	45,000
Total number of miles run by all trains,	198,260

Cost of work done and materials delivered and not paid for, and estimated cost of materials and work unfinished and necessary to be done (including land damages and fencing) to complete the whole road from Windsor to Burlington, October 31, 1850.

Grading, Bridging, Masonry, and Riprapping,	$77,460
Materials for Track, and laying,	10,980
Wharfing at Burlington,	8,400
Land Damages,	50,000
Depôts and Fixtures,	15,000
Fencing,	13,200
Ballasting,	30,000
Total cost of finishing the Road,	$205,040

Estimated cost of new road furniture required to accommodate the ordinary business of the road, exclusive of business from the Ogdensburgh road.

4 Locomotive Steam Engines,	at	$8,000	$32,000
5 Passenger Cars,	at	2,000	10,000
140 Eight-wheel Merchandize Cars,	at	600	84,000
26 Eight-wheel Platform Stake Cars,	at	500	13,000
10 Hand Cars,	at	100	1,000
12 Eight-wheel Merchandize Cars (part finished,)	at	360	4,320
Total estimated cost of new furniture,			$144,320

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*Railway Travel in Great Britain.**

The number of passengers on the railways last year (says a correspondent of the *Morning Herald*) exceeded double the population of the United Kingdom, those traveling by third classes alone exceeding the whole of the population—young, old, rich, and poor. As, however, it can scarcely be supposed that more than one quarter of the people have availed themselves of the advantages of railway transit, it will follow that each passenger, on the average, has gone eight trips in the year—a journey to

* From the London Builder, October 26, 1850.

any place and back with return tickets being considered generally as only one journey. The capital already raised by railway companies (says the same writer) exceeds one quarter of the national debt of Great Britain and Ireland, and would be sufficient to purchase the whole of the property in Ireland rated to the poor at twenty years' purchase on the poor-law valuation.——The aggregate amount of traffic on railways in the United Kingdom during the current year shows a very considerable increase over the corresponding period of 1849. The published total receipts from 1st January to 29th September, 1850, amounted to 9,525,707*l.*; corresponding period of 1849 to 8,275,679*l.*; showing an increase of 1,250,028*l.* for that period. The receipts during the first quarter of 1850 amounted to 2,613,237; second quarter to 3,214,903*l.*; and third quarter to 3,697,567*l.*; being an increase over the corresponding periods in 1849 of 283,001*l.* in the first quarter; 422,301*l.* in the second; and 544,726*l.* in the third quarter.

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*Statistics of Railways in Austria.**

According to a Vienna paper, the *Austria*, the railroads of the Austrian empire now embraces an extent of 290 Austrian miles (about 1400 English miles.) The traffic of these lines in 1849 was 1,236,361 passengers, and 17,880,800 quintals of merchandise. Other lines are in course of construction.

On an Improved Locomotive Boiler. By Mr. Ramsbottom, *of Manchester.*†

(Paper read at the Institution of Mechanical Engineers, Birmingham, July 25th, 1849.)

Without discussing the merits of the various arrangements and dispositions of the working parts of locomotive engines, the author of the present paper proposes to make a few observations respecting the most vital part of these machines, that upon which the satisfactory performance of all the details must necessarily depend—namely, the Boiler.

Before proceeding to the immediate subject of this paper, it is proposed to point out one or two objections to locomotive boilers as at present constructed, which experience has brought under the author's notice; and then to describe a form of boiler which appears to him in some degree calculated to remedy the defects which will be referred to.

It is scarcely necessary to observe that the absolute power of a locomotive, or any other steam engine, is strictly proportioned to the quantity of steam which the boiler of such engine can produce in a given time; and chemists are generally agreed that the quantity of atmospheric air required, (or oxygen, which is the supporter of combustion,) as well as the quantity of fuel, is in direct proportion to the quantity of water evaporated; or in other words, to produce more steam, it is not only necessary to supply more fuel, but also more atmospheric air in proportion to the quantity of steam produced.

* From the London Mining Journal, No. 787.

† From the London Civil Engineer and Architect's Journal, September, 1849.

It is well known that some of the locomotive engines built at the present day have from two to three times as much heating surface as those built about eight or ten years ago, and consequently when performing a proportionately increased amount of duty, they require from two to three times the quantity of air forcing through the fire in the same time.

The working parts of these engines have also been increased in dimensions; the cylinders from 12 inches to 15 and 16 inches diameter, the stroke from 16 inches to 20 and 24 inches, and the driving-wheels from 4 ft. 6 in. to 6 feet diameter, and in many cases even more.

Notwithstanding all these enlargements and improvements, there are however, two elements which have been but slightly changed—namely, *the diameter of the blast-pipe*, and the diameter of the *cylindrical part of the boiler;* and as the whole of the steam (after having performed its office in the cylinders) is driven in a forcible jet up the chimney for the purpose of producing the necessary draught through the fire, and as the power required to produce this jet is so much taken from the gross power of the engine, it follows that the smaller the blast-pipe is in proportion to the total heating surface of the boiler, the greater will be the resistance to the action of the piston, and the greater the loss of power on this account.

From observations made upon engines under the author's immediate superintendence, it appears that whilst the heating surface of locomotive boilers has been increased from 400 square feet (in the year 1842) to 987 square feet, (in the year 1846,) the blast-pipe has not been in the slightest degree enlarged, but on the contrary, in the latter case has been reduced in area in the proportion of $12\frac{1}{2}$ to $8\frac{1}{4}$ square inches. So that upon dividing the total heating surface or *area of production*, as it may be termed, by the size of the blast-pipe, or *area of eduction*, (assumed as unity,) the followng very instructive results are obtained:

No. of Engine.	When built.	Area of blast Pipe.	Heating Surface.
24	1842	1	4608
20	1842	1	5044
25	1845	1	7961
30	1846	1	12960

In the last case, then, it appears that the heating surface has been increased nearly *three-fold* in proportion to the size of the blast-pipe, as compared with Engine No. 24; and the reason will be obvious when it is stated that the Engine No. 30 is only of the same diameter as the first-named, (No. 24,) and consequently that the flue-room (which as a general rule will be as the square of the diameter of the boiler) has been but slightly increased, the extra heating surface having been mainly obtained by enlarging the fire-box, by putting in a mid-feather, and by increasing the length rather than the number of tubes.

It is not necessary to inquire how far the diameter of the cylinders may affect the size of the blast-pipe, nor to ascertain the amount of power which the blast-pipe absorbs, though it may be stated that experience proves it to range from 10 to 20 per cent. of the gross power of the engine, according to the number, diameter, and length of tubes, and also the speed of the engine. It may be remarked, however, that on

the average a degree of exhaustion is required in the fire-box under ordinary circumstances equal to a column of water 4 inches in height, and the degree of exhaustion in the smoke-box must of course be greater than this by the resistance offered by the tubes to the passage of the heated gases from the fire-box to the smoke-box.

From experiments made about 2½ years ago upon an engine with a total heating surface of 987 feet, carrying 147 tubes of 1¾ inch external diameter and 13 ft. 10 in. long, the author found that the latter force was at all velocities *three times* as great as the former; or in other words, that 66 per cent. of the total force of the blast was required to overcome the resistance offered by the tubes to the passage of the heated gases, leaving 33 per cent. only to operate upon the fuel; and it is this evil which results from the comparatively limited flue area of the boilers as at present constructed, to which attention is now more particularly called, and which it is proposed to remedy in the manner now to be explained.

From what has been said, it will readily be inferred that there is some difficulty in materially increasing the power of locomotive engines, as the necessary amount of heating surface cannot be obtained without increasing the diameter or the length of the boiler, or making it oval, to all of which plans there are some objections; but by the method now proposed it will be easy to enlarge both the fire-box and tube surface from 35 to 40 per cent., without increasing either the diameter of the boiler or its length, as will be now shown.

It is proposed to construct the copper fire-box with an arched roof, the top of which shall be nearly as high as the top of the cylindrical part of the boiler. This box may of course be made any length without sensibly reducing the strength of the roof, and will require none of the stay-bars which are so essential to the security of the flat-roofed box, and which for a moderate sized engine weigh not less than 400 lb.

With such a box the whole of the cylindrical part of the boiler can be filled with tubes, and of course the whole of the longitudinal stays be removed; and in the present instance there are 225 tubes of 2 inches external diameter, the shell of the boiler being 3 ft. 8 in. diameter and 10 feet long; the total heating surface of the fire-box is 80 feet, and of the tubes 1177 feet, making a total heating surface of 1257 feet. Such an arrangement involves the necessity of keeping the boiler full of water, and it is therefore requisite that a separate steam-chamber should be provided. This consists of a cylinder which is 13 feet long and 20 inches diameter, fixed over and parallel to the cylindrical part of the boiler, or, as it may now be termed, the generator. This tube, which has a cubic capacity of 28⅓ feet, is connected at each end with the generator. It is proposed that the water shall occupy about one-fourth of the capacity of this tube, leaving a clear space of say 21 cubic feet for steam; this is rather more steam-room than most modern boilers possess, and for reasons which are afterwards mentioned, the author thinks it will be sufficient, although it may readily be inceased by slightly enlarging the diameter of the steam-chamber, which as at present shown, is not so high as the ordinary steam dome by about 12 inches.

It has been proved experimentally by Mr. Robert Stephenson, that the generative power of the copper fire-box is three times as great per unit

of surface as that of the tubes; and independent of this authority, locomotive engineers are generally agreed that the great bulk of the steam generated in a locomotive boiler is formed upon the surface of the copper fire-box, and the first 18 or 20 inches length of the tubes. As the whole of the steam has to rise through the body of the water with which it is for the time mechanically mixed, and as the specific gravity of these mixed fluids will be much less than the comparatively *un*mixed water at the smoke-box end of the boiler, it follows that there will be a brisk circulation through the generator and steam-chamber. The mixed steam and water will be driven into the upper vessel, and will there be effectually separated; the former passing off to the cylinders by the longitudinal pipe, which has a number of small holes upon its upper surface, and the latter running again into the generator through the vertical connexion at the front end, and thus keeping up the circulation.

That the specific gravity of the mixed steam and water at the fire-box end is often reduced to at least one-half that of water alone, is proved by the fact that the water gauge will frequently show a downward current through the glass tube, even though the circulating fluids be one-half water and one-half steam, showing as it does that the column of the mixed fluids in the boiler is specifically lighter than the column in the glass gauge; and from this fact it is also evident that this great expansion is confined to the water in the vicinity of the fire-box, since if it extended to the whole mass, the boiler would not contain the requisite quantity.

From the circumstance that no bubble of steam can rise into the steam-chamber between the points marked A and B, it is concluded that this boiler will not be so liable to prime as the common one, and therefore that the steam-chamber as shown is sufficiently large. As to the water surface, which in this boiler it may be objected is smaller than in others, it is conceived that the great facilities this boiler will give to the engineer for raising steam, will leave him comparatively at liberty to put in water when and where he chooses, and consequently that but little difficulty need be apprehended on this point. It is evident, however, that the objection may be fully met by constructing the outer fire-box with a pyramidal roof in the way so common.

In conclusion, the author would express his conviction that this boiler, combining as it does, a great increase of heating surface, *and corresponding increase of flue area*, with a relative diminution of bulk and weight, and great simplicity of construction, is calculated to remove some of the difficulties experienced by locomotive engineers, and to promote the best interests of the railway world in general.

Remarks made at the Meeting after the reading of the foregoing Paper.

The Chairman said, that in the unavoidable absence of Mr. Ramsbottom, he would observe that his object in the foregoing paper was to obtain a considerably larger area of flue-room than in the present locomotive boilers, and to make a boiler of a large heating surface with less weight.

Mr. Slate was of opinion, that for the weight the engine carried, it would have a considerably greater effective heating surface than any pre-

vious form of boiler; but he thought the boiler would have as great a tendency to prime as any other.

Mr. Cowper was also of opinion there would be a great tendency to prime in the proposed boiler; the surface from which the steam had to rise was the entire surface of the fire-box and tubes, and all the steam had to pass through the two openings into the steam-chamber, and it appeared to him the water would be carried up there in a complete state of froth.

Mr. McConnell, while agreeing to a certain extent as to the liability of the boiler to prime, thought it might be obviated by having a more continuous communication between the generator and the steam-chamber; perhaps the steam-chamber could be fixed close upon the top of the generator, and a continuous longitudinal opening be made, communicating between them throughout the entire length. He thought the proposition of Mr. Ramsbottom was a very good one, as it was a received opinion that the proportion of the flue-room to the fire-grate surface could not be too large, supposing that full advantage was taken of the flue surface before the heated air reached the chimney. Whether long tubes or short tubes as applied to locomotives were most advantageous, was a question not yet decided, and he thought they had scarcely data enough to determine as to the advantage of long tubes on the ground of economy. It was a very important matter to determine what length of tubes was most advantageous for use in proportion to the area of the fire-grate.

Mr. C. Cowper was not aware whether there was any authority respecting the proportionate heating power of the tubes and the fire-box, besides the experiment of Mr. Stephenson alluded to in the paper.

Mr. McConnell remarked, that it appeared from experiments made by Mr. Stephenson and Mr. Beyer, that a very considerable heat was lost in the smoke-box even at the end of the longest tubes that were used; and he thought that the air in the centre of the tubes might have a considerably higher temperature than the air at the sides of the tubes, and that much of the heat might be carried through by a stream of air like a solid bar in the centre of each tube, without ever coming in contact with the sides of the tube, and consequently without being communicated to the water of the boiler. He had been informed that it was found to be a useful practice in marine and stationary boilers, to create a disturbance in the currents of air passing through the flues, for the purpose of mixing up the particles as much as possible; and a similar advantage might probably be obtained by mixing the air in the tubes of locomotive boilers.

Mr. Gibbons said he had observed a similar advantage from mixing the particles of air in heating the air for his blast furnaces near Dudley; the pipes through which the air was passed for the purpose of heating it were bent like a syphon, so as to cause all the particles of air to come in contact with the sides of the pipes, and the air was found to be heated much more efficiently by these bent pipes than by straight pipes.

Mr. Allan said he had tried an engine with a $\frac{1}{2}$-inch iron rod fixed in the centre of each tube; the rods were as long as the tubes and supported at intervals by short projecting pins to hold them in the centre of

the tubes. The engine had been worked with them for some time between Birmingham and Liverpool, but no difference was found in the working and consumption of coke, as compared with the same engine doing the same work without the rods in the tubes; the result was found to be exactly the same in both cases.

Mr. C. Cowper remarked that the rods in the tubes would have the effect of contracting considerably the flue area, and increasing proportionately the amount of power requisite to draw the air through the tubes, and consequently the rods in the tubes would cause a loss of power to the engine from the increased resistance to the blast. He thought, therefore, the rods must have caused an equal amount of gain to neutralize this loss, by bringing the air into more effective contact with the sides of the tubes; as the result showed no loss on the whole.

Mr. McConnell thought it was certain at least, that the use of the rods did no harm; and it must either be considered that there was no advantage in a large flue area, or that there was considerable advantage in mixing the air in passing through the tubes.

Mr. Slate was of opinion that even on the ground of economy a large number of tubes was advisable, because with the violent and frequent action of the pieces of coke the tubes were soon worn out; whereas, by increasing the number of tubes, the velocity of the draft would be diminished, and the tubes would be less worn, and would last longer.

The Chairman remarked, that the larger the area of the flue, the better it was for the engine, as it must offer less resistance to the blast-pipe; but he was not certain what this resistance actually amounted to.

Mr. Cowper said that Mr. Daniel Gooch had found from his indicator cards, that the resistance of the blast-pipe amounted to 11 or 12 lb. per square inch, at a moderate velocity of about 30 miles an hour.

Mr. McConnell observed, that as a certain quantity of heated air had to be conveyed from the fire-box to the chimney, and a certain area of heating surface was also required, there would be an important reduction effected in the resistance of the blast-pipe by increasing the number of tubes, so as to increase the area of passage and reduce the length of the tubes, diminishing proportionately the resistance of the air passing through the tubes.

The Chairman said he was present when the experiments were tried that were mentioned by Mr. Ramsbottom, to ascertain the difference between the degree of exhaustion in the smoke-box and the fire-box; the experiments were tried with a long boiler engine, and a glass water gauge was fitted into the smoke-box and another into the fire-box. The degree of exhaustion in the smoke-box averaged three times as great as that in the fire-box, and this proportion was found to be nearly the same at all velocities; the greatest amount of exhaustion observed in the smoke-box supported a column of water 13 inches high. He thought that the whole resistance of the blast-pipe and the back pressure in the cylinder; did not amount to more than 15 per cent. of the power of the engine.

Mr. Slate remarked, that assuming it to be 15 per cent. it followed that 10 per cent. of the whole power of the engine was absorbed by the friction of the air in passing through the tubes, as the exhaustion

in the smoke-box was three times as great as in the fire-box; or one-third only of the pressure of the blast was effectively acting in the fire-box.

Mr. McConnell thought it was an important subject for investigation, to ascertain the actual power lost by the resistance of blast-pipes of different sizes, and under the different circumstances of size and number of tubes. In his own practice he found that small tubes and many of them produced the best effect; the limit in reducing the size of the tubes was their stopping up with pieces of coke whilst working.

The Chairman said he thought there was some advantage in the form of boiler proposed by Mr. Ramsbottom, and that amongst the various modifications that had been proposed of the locomotive boiler, there was not one that was likely to be so useful.

AMERICAN PATENTS.

List of American Patents which issued from November 12 *to December* 10, (*inclusive.*) 1850, *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

17. For an *Improved Filter for Oils;* Thomas Antisell, City of New York, November 12.

"The nature of my invention consists in the employment of a filter made as hereinafter described, by the forcible compression of which downwards through the liquid to be filtered and purified, the thinner liquid is separated from the more solid parts, and is made to pass upwards through the filter, above which it may be drawn off by suitable arrangements."

Claim.—"I do not lay claim to the congealing of oils by cold, nor to the use of a screw to exert pressure; but what I do claim as my invention, is the use of a filter formed as described, carried downwards by pressure, under the force of which the oleic acid is filtered upwards, and which, applied in connexion with the arrangement described for applying cold, allows oils and fats to be purified in warm weather."

18. For a *Machine for making Jack Chains;* Charles Atwood and George Kellogg, Birmingham, New Haven County, Connecticut, November 12.

Claim.—"What we claim as our invention, is the combination of the parts, movements, and operations in one machine, which are required to make jack chains by one process from the straight wire, after it is cut off in suitable lengths, to finished chain, substantially as described.

"We also claim particularly the stud-pin with a recess in it, substantially as herein described; that is, the use of it as a mandrel, around which the bow of a link is bent, while the bow of another link is held in the recess, thereby forming a continuous chain, and irrespective of the mechanical devices by which it is moved or used.

"We also further claim the partly revolving mandril, with its stud and nipper, and other appendages for bending the last bow of each link, substantially as combined and used in our machine and constituting part of it."

19. For an *Improvement in Repeaters for Electro-Magnetic Telegraphs;* Charles S. Bulkley, Macon, Bibb county, Georgia, November 12.

Claim.—"What I claim as my invention, is the manner of connecting two galvanic circuits with the two electro-magnets (*a a* and *d d*) in the said repeater, substantially as herein represented and described, to wit: each of the said galvanic circuits, as it passes through my said Telegraphic Repeater, embracing in its course the armature of the opposite electro-magnet—in the said instrument—previous to its passing through the helices in the electro-magnet embraced in its own respective circuit.

"In combination with the above, I also claim the connecting the points, with the galvanic battery, (or batteries,) when the said points are placed in such positions in relation to the armatures, of the electro-magnets in my said Telegraphic Repeater, that when either one of the said electro-magnets is charged, it will, by attracting its armature against one of the points *b*, or *j*, close the poles of the galvanic circuit in which the opposite electro-magnet (in the instrument) is in connexion, and thereby throw the battery into the said circuit, substantially as herein set forth."

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20. For an *Improvement in Seed Planters;* Samuel Cannon, New Richmond, Crawford county, Pennsylvania, November 12.

Claim.—"What I claim as my invention, is the attachment of my vertical cylinders to the rear of my ploughs or cultivator (without regard to any particular plough) in combination with its machinery, arranged substantially in the manner and for the purposes herein set forth."

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21. For an *Improvement in Printing Machines;* Oliver T. Eddy, Baltimore, Maryland, November 12.

"*Claim.*—"What I claim as new is—1st, I claim the type form, constructed substantially as described and represented, viz: with the types arranged in rows, longitudinally and laterally, in such manner as to permit each type to be brought to a given position, at the will of the operator, to be pushed upon the paper by the plunger or its equivalent.

"2d, I claim the combination of the two motions, which I have called lateral and longitudinal, for the purpose of bringing the type or character required in position to make its impression.

"3d, I claim the wedge-shape movement in combination with a type form, substantially as described and represented, for the purpose of giving motion to the latter.

"4th, I claim the manner of adjusting with precision the required position of the type form, by the use of gauges, substantially as described and represented, in combination with the two motions already described as giving motion to the type form, or in any combination substantially the same.

"5th, I claim the inking of the types, by the inker interposed, during the action of the machine, between the face of the types and the paper.

"6th, I claim the use of the bob, substantially as described and represented, to furnish the power to cause the pressure on the types, or the inking of the same.

"7th, I claim the combination of the bob, whose fall produces the pressure on the types, with a contrivance by which, after the blow is given, a second blow or vibration is prevented.

"8th, I claim the use of the slats, substantially as described and represented, or other analogous device, controlling the motion of the machine, combined with the rods answering to the letters or characters wanted, by means of the catcher on which the slats may be moved separately or together, in any combinations of time or extent of motion that may be required for the action necessary to produce the given character.

"9th, I claim the draft rod and lever, in combination with the slat, or its equivalent, to produce the various movements required to control the types."

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22. For an *Improvement in Horse-Shoe Machinery;* Samuel S. Greene, Lowell, Middlesex county, Massachusetts, November 12.

Claim.—"What I claim, is the combination of the two flanched rotating dies arranged with respect to each other, and operating substantially as herein described; said dies being so shaped as to give the requisite form to the metallic shoes of animals."

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23. For an *Improvement in Drying Paints;* Aquilla Jones, City of New York, November 12.

"The nature of my invention consists in providing a new material as a drying substance to be mixed with linseed or other oils, to be used in zinc and other paints, in order that the oil so prepared will cause the paints to dry more effectually than in the known processes."

Claim.—"What I claim as my invention, is a method of giving a drying quality to oils by the use of a mineral commonly known by the name of the "Red Oxide of Zinc,"

in a partially deoxidized state, and either in combination with those substances naturally associated with it, or by the use of any of its component parts, separated by mechanical means."

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24. For an *Improvement in Iron Railings;* John Krauser, Sommers Crowell, and Cyrus Krauser, Reading, Berks county, Pennsylvania, November 12.

Claim.—"What we claim as our invention, is the combination of rods, tubes, and pailings, with the manner of operating the same, as herein set forth and described."

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25. For an *Improvement in Cooking Stoves;* Samuel Pierce, Troy, Rensselaer county, New York, November 12.

"My invention consists in heating the front end of the said oven with hot air, by causing air to enter a heating chamber back of the fire-back, and then to pass along a flue or flues in the hearth to the front end of the extended oven, and thence through the oven, escaping into the back fire flues of the stove through holes in the back oven plates; the exhausting action of the draft in the fire flues inducing the required current of heated air as above indicated. In this way I am enabled to produce, by a single device, the double effect of heating the front end of an extended oven, and at the same time to keep up a circulation of heated air in and through the oven."

Claim.—"What I claim as my invention, is the method of heating the front end of the extended part of the oven, in combination with, and receiving the heated air from, the hot air chamber behind the fire back, and causing it to pass through the oven and out into the fire flues, in the manner substantially as described, and for the double purpose of heating the front end of the oven and passing a current of heated air through the oven, substantially as specified."

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26. For an *Improvement in Sewing Machines;* Allen B. Wilson, Pittsfield, Berkshire county, Massachusetts, November 12.

"The nature of my improvements, which are applicable to a machine in which two threads are used, viz: one passed through the cloth by a needle leaving a loop through which another thread is passed by a shuttle, consists, firstly, in an improved mode of operating the vibrating arm which carries the needle; secondly, in an improved mode of operating the shuttle by which I can pass a thread during each of its motions, one during its motion in one direction, and another during its motion in the opposite direction; and thirdly, in an improved mode of holding and moving the cloth to be stitched."

Claim.—"What I claim as my invention, is forming a stitch by each throw of the shuttle and corresponding motion of the needle; that is to say, making one stitch at each forward and another at each backward motion of the shuttle; this being effected by the needle in combination with the shuttle, both constructed, arranged, and operating as herein described, or in any other mode substantially the same.

"2d, I claim the combination of the sliding bar, the plate, *r*, the feeding plate V, the spring, the screw, the lever, and the clamping plate, for holding and feeding the cloth to the needle and regulating the length of the stitch, in the manner herein described, or in any way substantially the same."

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27. For *Hinged Gun-Harpoons;* William Albertson, New London, Connecticut, November 19.

"The nature of my invention consists in making the shanks of harpoons, or other whale irons, with a hinge joint at or near the middle of their length, which admits of their being folded, and inserted nearly up to the head, within the barrel of a gun, being so formed as to fit easily in the said barrel; the line is made fast to the shank close to the head and also at the end, the part of the line between the head and the end of the shank which lays close to the shank during the flight of the harpoon, or while the shank is straightened, is folded when the shank is in the gun, and hangs outside in the form of a loop: by this contrivance the line can be made fast to the end of the shank, as well as near the head, without placing it in the barrel of the gun, and the shank (each joint being in the form of half a cylindrical tube, or otherwise hollowed out for the sake of lightness) may be made to fit the barrel of the gun so as to be capable of being projected with great accuracy, without rendering it necessary to make it of great weight."

Claim.—"What I claim as new in my invention, is, making the shank of harpoons and other whale irons, to fold by a hinge or joint at any convenient point in their length, in the manner and for the purposes substantially as herein described."

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28. For an *Improvement in Bake Ovens;* Hosea Ball, Philadelphia, Pennsylvania, November 19.

Claim.—"What I claim therein as new, and of my invention, is, the combination and arrangement of an endless chain platform, with the oven, by which arrangement the unbaked bread or other articles being put in at one end, are discharged at the opposite end completely baked; and in combination therewith, I claim the self-opening and closing door, arranged substantially as herein set forth."

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29. For an *Improvement in Working the Doors of a Bee-hive;* Jarvis Case, Selma, Ohio, November 19.

Claim.—"What I claim as my invention, is the arrangement of the bee boxes and moth chambers, in combination with the sliding screen doors, pulleys, and levers, as described, so that the doors may be worked by a single movement of the lever, in the manner and for the purposes set forth."

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30. For an *Improvement in Air-heating Furnaces;* Gardner Chilson, Boston, Massachusetts, November 19.

Claim.—"What I claim as new, is, 1st, the annular chamber, constructed and arranged substantially in the manner and for the purposes set forth—with or without the cross pipe.

"2d, I also claim the mode of conducting off the products of combustion from the fire through ascending pipes, into an annular chamber, and thence into a central descending pipe to their exit; and the surfaces being all so constructed of a curved figure, as to allow a diverting influence, and free circulation to the exterior air in the air chamber, to be warmed without over-heating it; while it is, by the arrangement of parts, forced to impinge directly against the heated surfaces.

"I also claim the method of setting the furnace, consisting of a double-walled chamber, the inner wall of which encloses a cold air trench, supplied from without, that surrounds the ash-pit, with openings at its top for the proper admission of air into the air chamber around the furnace, and with lateral openings into the space between the walls to cause an upward current, which is connected with the warm air pipes leading to the apartments, by means of which a constant and pure supply of air is insured, and the heat greatly economised."

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31. For an *Improvement in Corn Shellers;* David Eldridge, Philadelphia, Pennsylvania, November 19.

Claim.—"What I claim as new and my improvement, is the combination of the wheels, C, D, and E, for shelling corn, as herein described."

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32. For an *Improvement in Mills for Grinding and Crushing;* William Frost, City of New York, November 19.

"The nature of my invention consists in the use of a round cylinder mounted on a shaft, and driven by hand, steam, or other power, in grooves of the cylinder; inside are crushers or rollers of a peculiar form, containing, if necessary, similar crushers within themselves all of which when the cylinder revolves rotate by the friction against their peripheries and are used for breaking, bruising, or grinding different substances put into the cylinder, the outlets and inlets for the material operated on, also the crushers and position of the machine, being made according to the particular purpose for which the machine is intended."

Claim.—"What I claim as my improvement is the use of the cylinder, grooved and notched, or smooth, being made to rotate, and having within it any number of crushers, formed as described, for the purpose of pounding, grinding, or mixing any substance; the crushers either running singly or for the purpose of working different substances simul-

taneously one within another; the jumping bar or pins at N, in combination with the arrangement shown, or any other arrangement substantially the same."

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33. For an *Improved Annunciator or Bell Telegraph;* John Garvey, City of New York, November 19.

Claim.—"What I claim as new and of my own invention, is the combination and arrangement of the spring levers, suspended bar or striker, with the pendulums and bells, for simultaneously indicating the number of the room, and calling the attention thereto by giving the alarm ; there being a secondary or intermediate fulcrum bar against which the spring lever impinges on its descent, increased by the spring by which the rear end is made to descend, and with it the suspended striker, upon the bells, and at the same time suddenly elevating the front end of the lever, and imparting a vibratory movement to its pendulum; said spring levers being provided with oblong openings or slots, through which the fulcrum bar passes, for producing the aforesaid action of the spring levers on its descent upon the intermediate fulcrum bar, as described and represented."

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34. For an *Improvement in Photographic Pictures on Glass, &c.;* Frederick Langenheim, Philadelphia, Pennsylvania, November 19.

"The nature of my invention consists in placing a semi-transparent material or substance, for example, ground or frosted glass, in front or behind the said transparent picture, the effect of which is to concentrate the light in the ground or frosted glass, at the same time preventing objects behind the picture from being visible through the lighter or more transparent parts of the picture, and which ground or frosted glass also protects the picture from external injury."

Claim.—"What I claim as my invention, is the combination of the ground or frosted glass, or other semi-transparent substance, interposed in connexion with the picture, between the source of light and the spectator, substantially as described in the foregoing specification."

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35. For a *Method of Attaching Augers to their Handles;* John E. Larkin, Ballston Spa, Saratoga county, New York, November 19.

Claim.—"What I claim as new in my invention, is the handle, made in two parts, one of which, D, fits in a socket on the other, A, and carries a bolt screwed at its end; the said bolt passing through a hole in the auger shank, and screwing into a female screw or nut in the part A, for the purpose of clasping or firmly holding the auger shank between the ends of the parts A and D of the handle or stock, substantially in the manner herein described."

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36. For an *Improvement in Copper and Steel Plate Printing Presses;* Elijah C. Middleton and Edward Nevers, Cincinnati, Ohio, and Robert Neale, Mount Carmel, Ohio, November 19.

Claim.—"What we claim therein as of our invention, is, 1st, the arrangement of a tooth or catch projecting from the roller, and operating upon a tooth or projection upon the platen for the purpose of starting the platen and causing the commencement of the convexity of the roller to impinge upon any required point of the length of the platen, for the purpose described.

"2d, The combination of the racks with the cog wheel attached to the connecting rod of a gang of rollers, together with the beads and the grooves in the rollers for security, uniformity of action, and a proper relative position between the platen and the supporting rollers upon which it traverses, thus preventing lateral and longitudinal aberration.

"3d, The method of heating and retaining at a suitable temperature the plates from which the impressions are to be taken, by means of lamps, or of vessels containing inflammable material, placed under the upper plate of the platen or traversing bed, within the recess formed between that and the plate resting immediately upon the gang of rollers.

"4th, The arrangement of a stationary and sliding clamp, adjustable longitudinally of the platen, for securing the plate in position, substantially in the manner described.

"5th, We claim in combination with the D roller the method of retracting the platen by the weighted cord, assisted by making an inclined plane of the bed on which the rollers traverse."

37. For *Improvements in Excavating Machines;* Martin Newman, Jr., Lanesborough, Susquehanna county, Pennsylvania, November 19.

"The nature of my invention consists in a rotating cylinder or drum, hung in suitable frame work, so constructed that it can be elevated or depressed, or moved in either direction sideways; the cylinder is driven in either direction by a band or chain from a pulley actuated by suitable mechanism; attached to the band or chain is the bucket or scoop which digs out and carries away the earth; this is provided with wheels, and while it is net upon the drum, runs up on a railway on the frame, but when it comes in contact with the drum, it has a motion in a circular direction, and at that time it is intended to perform its operation, being returned along the railway when full by reversing the motion of the band or chain until it reaches the back of the frame, when the bottom is caused to fall or open and discharge the dirt."

Claim.—"What I claim as my invention, is, 1st, operating the bucket by giving motion to the band or chain, and to the drum in one direction to fill the bucket, and then reversing its motion so as to draw back the bucket to be emptied, in the manner substantially as herein described.

"2d, I claim the manner substantially as herein described of closing the bottom or trap of the bucket by means of the spring or incline, over which it passes in its forward passage."

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38. For an *Improvement in Pessaries;* Jonathan Hovey Robinson, Charlestown, Middlesex county, Massachusetts, November 19.

Claim.—"What I claim is the solid connector with its connecting contrivance, (or its equivalent,) and joint in combination with the supporting stem, the whole being substantially in the manner and for the purpose as herein before specified."

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39. For an *Improvement in Extension Tables;* Edwin F. Shoenberger, Pittsburg, Allegheny county, Pennsylvania, November 19.

"My invention consists in the construction and combination of the several sections of extension tables, bedsteads or other articles, in such a manner as to slide inside of each other, so that when the several parts are pushed together, the whole shall be enclosed in one section."

Claim.—"What I claim as my invention, is not the construction of tables or other articles, and requiring extension, in sections, because that has been known and used before; but what I do claim as my invention, is the construction of extension tables in such a manner as that the sliding parts when extended shall constitute a table complete without any replacing of panels to form the leaf, substantially in the manner herein before set forth."

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40. For an *Improvement in Spark Arresters;* Samuel Swett, City of New York, November 19.

Claim.—"What I claim as my invention, is combining, in the manner substantially as described, with the chimney, the surrounding jacket and the cap, a valve for governing an aperture in the top plate of the cap, so balanced or weighted that it shall open by gravity when the furnace is working under a draft due to the rarefaction of the column, and be closed by the force of the current when increased by the exhaust steam in the chimney, for the purpose and in the manner substantially as described.

"And I also claim in combination with the valve and the wire gauze, or the equivalents thereof, and the deflector over the chimney, all arranged substantially as herein specified, the central tube of the deflector and the conical ring within the wire gauze, substantially as herein specified and for the purposes set forth."

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41. For an *Improvement in Bedsteads;* Wilhelm Raiser, Cincinnati, Ohio, November 19.

Claim.—"What I claim therein as new, is the combination of the slats, clasps and hooks athwart the length of the outside slats, in combination with the rails and latches on the posts, the whole combining to form a strong and portable bedstead."

42. For *Improvements in Machines for Feeding Nail Plate;* Frederick J. Ayres, St. John, New Brunswick, November 26, 1850.

"Having thus described my improved feeding apparatus for a nail-cutting engine of the kind above stated, what I claim therein is as follows:

"Although I have described particular mechanism as applied to the frame, for raising the strip of metal high enough above the bed die to admit of its being turned over as explained, I do not claim such mechanism in itself separate, or uncombined with the frame and machinery by which the strip of metal is progressively advanced towards the dies, but what I do claim is the combination of such raising mechanism with the machinery for imparting to the strip of metal its progressive forward movements as specified; the mechanism so combined with the said machinery, being the bale, the rod, the lever or arm, the crank, shaft, drum, belts, and the arms l', m', of the lever beam; the whole being arranged, and made to operate together substantially as specified.

"And I further claim, in combination with the mechanism which produces the progressive advancing movements of the strip of metal towards and between the cutters, the mechanism for producing the retrograde movement of the pincers, after the strip of metal has been entirely operated upon by the cutters; such mechanism being the pulleys, the endless belt, the movable frame, and clutch, or their equivalent, the vertical rock shaft, and its arms, the cams, the lifting bar, and its spring catch, together with the slide, and its projections, the whole being constructed and made to operate together essentially as specified. And I claim the combination of the arm z,[2] with the shaft w,[2] and the mechanism for moving the clutch, the said arm being for the purpose of creating a retrograde movement of the clutch, so as to unclutch the pulley t,[1] from the shaft e, and this when the entire retrogradation of the nippers has been effected the same being accomplished as herein before specified.

"And in combination with the mechanism which produces the reciprocating rotary movements of the nippers or strip of metal held thereby, I claim the combination of mechanism for arresting or stopping such rotary motion immediately on the final retrogradation of the pincers taking place, such mechanism being the levers z,[4] and n,[3] the connecting rod p,[3] arm g,[3] shaft r,[3] arm s,[3] spring catch y, as applied together and to the lever beam, and lifting bar y,[2] as described.

"And I claim the combination of mechanism by which the progressive advancing and intermittent secondary retrograde movements of the strip of metal are produced, the same consisting of the long bar l,[2] and its connecting frame p,[2] the feed and pressure rollers, the shaft g,[2] and pulley, the strap or belt, and its rods, the levers z,[1] and v,[1] connected together as described, and the cams on the shaft e. And in combination therewith, and the lifting bar y,[2] I claim the bent lever i,[3] the same being applied to the same, and used for the purpose substantially as herein before specified."

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43. For an *Improvement in Cutters for Planing Machines;* Enos G. Allen, Boston, Massachusetts, and Charles Briggs, New Bedford, Massachusetts, November 26.

Claim.—"What we claim as our invention is, arranging a series of shaving knives in continuous succession upon the periphery of a conoidal wheel, whereby a continuous serrated shaving instrument is produced whose uninterrupted action by preventing jarring produces a smoother surface."

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44. For an *Improvement in Ship Ventilators;* Ralph Bulkley, City of New York, November 26.

"The nature of my invention consists in providing ventilators with floatable valves to be acted upon by the water which casually rises in contact with the ventilation, whereby the air orifice of the ventilator becomes closed during the time the water remains in contact with it."

Claim.—"What I claim as my invention is, the combination of 'floatable valves' with ventilators for ventilating vessels and steamers, and the combination of 'floatable valve ventilators' with vessels and steamers. The valves to be acted upon, by the raising and the falling of the water when in contact with the ventilator. The rising water to cause the valve to close the air orifice and prevent the entrance of water, and the falling water to permit the valve to recede by its own gravitation, and thereby open the air orifice. The devices and operations of the same as herein described, for the objects and purposes herein set forth."

45. For an *Improvement in Gang Ploughs;* Henry Cowing, New Orleans, Louisiana, November 26.

"The object of my invention is to furnish to the agriculturist a labor-saving machine, whereby steam may be profitably employed instead of manual labor or horse-power, in ordinary field operations, and elsewhere, especially in ploughing and cultivating land."

Claim.—"I claim the inclined coulters, so arranged as to throw out the ploughs without breaking, when they meet with an obstruction, in the manner and for the purpose set forth.

"I claim the apparatus shown at *n*, *m*, fig. 5, for setting the frames for hilling in the manner above specified."

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46. *For Improvements in Hanging Carriage Bodies;* M. G. Hubbard, Geneva, Ontario county, New York, November 26.

Claim.—"What I claim as new therein is the combination of elastic cross reaches, with a non-elastic centre support, the reaches being so connected with the centre support that they shall be free to bend throughout their length, substantially in the manner and for the purpose described."

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47. For an *Improvement in Processes for Rendering Cordage Uninflammable;* M. Y. Johnson, New Orleans, Louisiana, administrator of James H. Johnson, deceased, late of New Orleans, Louisiana, November 26.

Claim.—"What I claim as my invention, is my improved process of rendering vegetable fibrous substances uninflammable and preserving them in that condition, substantially as herein set forth."

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48. For an *Improvement in Fountain Pens;* Charles W. Krebs, Baltimore, Maryland, November 26.

"The nature of my invention consists in the conical shape of the open end of the tube, which prevents the ink from running out too fast; and also in providing a screw inside of the tube to control the pen, or nib, and extend it beyond and outside of the tube, or to withdraw it inside of the tube when not in use."

Claim.—"What I claim as my invention, is the pen nib made to project through the conical termination of the fountain, substantially in the manner and for the purpose set forth, and in connexion therewith I claim making the pen nib adjustable substantially as described."

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49. For an *Improved Method of Securing Rails of Rail-roads;* H. H. Mary, Galesburgh, Knox county, Illinois, November 26.

Claim.—"What I claim as new is the diagonal position of the horns, by which, with the aid of the arms and clamps, the rails are secured in their position."

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50. For an *Improvement in Sausage Stuffers;* Simon McNair, Hattborough, Montgomery county, Pennsylvania, November 26.

Claim.—"What I claim as my invention is the introduction of a tube or case, D, into the case or cage, B, of a press and adapting it thereto in such manner as to form a sausage stuffer in combination therewith, which is operated by the same power and under the same piston and rod that acts upon the press, as herein substantially set forth."

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51. For *Improvements in Screw Threading Machines;* Thomas J. Sloan, City of New York, November 26.

"My present improvements relate to the method of threading wood screws by a series of chasing operations, and for doing this on pointed screws."

Claim.—"What I claim as my invention is the before-described, method of operating the jaws for griping and liberating the blank by means of the toggle joint and rod connected therewith, when this is combined with the method substantially as described of latching and unlatching the rod by means of the sliding collar acting on the inclined or beveled stem of the rod to draw it back, and force in the latch and then holding it in

place by passing on to it, so as to avoid an endwise strain on the mandril against its boxes, substantially as described, and for the purpose specified.

"I also claim so connecting the mould which governs the line of motion of the chaser, with the sliding frame, that it shall be free to vibrate therein, in manner substantially as described and for the purpose specified."

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52. For an *Improvement in the Locking Apparatus of Repeating Fire-arms;* Joshua Stevens, Chicopee, Hampden county, Massachusetts, November 26.

Claim.—"My improvement, and what I claim as my invention, consists in hinging the dog or catch to the bolt, in combination with so making and applying the recess, and the spring together, and to the dog or catch, as to cause said spring to perform two functions, or to not only operate the dog or catch, but to operate the bolt, essentially in the manner as above described."

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53. For an *Improvement in Shuttle Motions in Looms;* Thomas T. Willcox, Norwich, New London county, Connecticut, November 26.

"My invention consists, firstly, in an improved method of regulating the operation of the picker staves, so as to throw the shuttle with greater or less force as may be required; the picker staves are operated so as to throw the shuttle, by means of the flat bar springs, attached to oscillating boxes, which are mounted on fixed centres attached to the rocker, the ends of the springs bearing on short levers attached to the picker staves; the lower sides of the oscillating boxes are of semi-circular form and are attached together by chains which are provided with a regulating screw, for the purpose of lengthening or shortening them and regulating the force exerted by the springs.

"It further consists in forming the cams for operating the levers which draw back the picker staves, in such a manner as to prevent damage to the warp or to the mechanism, in case of the motion of the loom being accidentally reversed."

Claim.—"I claim the boxes, oscillating upon fixed points, and having the flat bar springs attached to them, in combination with the chains, and the regulating screw and nut; for giving a more free and easy motion to the picker staves, and for the more effectually controlling and graduating the amount of pick."

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54. For a *Combined Boiler, Cupola, and Grate;* Loftis Wood, City of New York, November 26.

Claim.—"What I claim therein as new is the boiler descending from the top to the bottom of the cupola in combination with the removable grate, the water contained in the boiler surrounding the heated iron and coals substantially as described.

"I do not claim the use of the subsidiary grate, but I do claim it as making a part of the combination necessary to the proper and perfect action of my combined steam boiler and cupola smelting furnace."

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55. For an *Improvement in Cooking Stoves;* Loftis Wood, City of New York, November 26.

"The nature of my improvement consists in placing one or more ovens between one or more fires on each side, and dividing the grates into compartments, to make a large or small fire, heating one or more ovens, as may be desired, and having a flue dividing the ovens, through which the heated air passes over the ends of the ovens, after passing over the top, two sides, and bottom of the same."

Claim.—"What I claim as my invention is placing one or more ovens between one or more fires on each side, in connexion with a vertical flue, or flues, passing between the ovens, separating them substantially as described."

RE-ISSUE.

1. For *Improvements in Machinery for Turning Irregular Forms;* Timothy Clark, New Haven, Connecticut; patent dated January 19, 1847; re-issued November 12, 1850.

Claim.—"What I claim as my invention is the arrangement of the cutter wheel, or saws, so as to cut in the direction of the grain of the wood or other substance to be

formed, when this is combined with the rotation of the pattern and substance to be formed during the operation of the cutters, substantially as described.

"I also claim the rotating cutter wheel constructed substantially as herein described of a series of circular saws, secured in an inclined position to an arbor which carries them as herein set forth."

DESIGNS.

1. For a *Design for Bas-relief of Henry Clay*, Charles Younglove Haynes, Philadelphia, Pennsylvania, November 12.

Claim.—"What I claim as my design is the combination of scroll-work and vignette which forms the ornamental tablet, the shield, on which history is recording the extract of Mr. Clay's address, together with the side-view attitude in which he is represented, and the ornamental tablet on which he stands, from which copies may be taken, for sale or use, either by casting, moulding, embossing, or in any manner, or with any material whatever in bas-relievo, or by copies to be taken, by painting, drawing, sketching, etching, engraving on wood or metal, or by any material spread upon it, or by the electrotype, Talbotype, or Daguerreotype process, or by ruling with machinery, or in any other manner whatsoever."

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2. For a *Design for Stoves;* Reuben J. Blanchard, Albany, New York, assignor to Billings P. Learned and George H. Thatcher, of Albany, New York, November 12.

Claim.—"What I do claim as my invention is the bunch of leaves tied together, as seen in fig. 1, and the leaf ornament in fig. 2, as such a design as above mentioned."

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3. For a *Design for Stoves;* Apollos Richmond, Providence, Rhode Island, assignor to A. C. Barstow & Co., Providence, Rhode Island, November 12.

Claim.—"What I do claim as my invention or production, is the combination of the several ornamented parts of the stove, viz: the the base plate or hearth, having the diamonds and clustered beak heads cast thereon, as described, the side and back plates having a plinth with semi-pyramidal ribs, gothic arches, diamonds, beak heads, and band at top with inverted semi-pyramidal beak heads, the cap with its circular ornamented areas, and diamonds surrounding beak heads, and the vase with its exterior ornaments of diamonds, clustered beak heads, semi-pyramidal ribs, and open work diamonds; all the mouldings, beak heads, and ribs being cast in alto-relievo, as herein above described, and represented in the drawings, the whole combination forming an entirely new design for the exterior of a parlor air-tight stove."

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4. For a *Design for Stoves;* D. Root, Cincinnati, Ohio, November 12.

Claim.—"What I claim as new is the design formed and ornamented substantially as above described, and represented in the accompanying drawings."

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5. For a *Design for Carriage Plates;* J. S. Royce, Cuylerville, Livingston county, New York, November 19.

Claim.—"What I claim as my invention is my design for an ornamental carriage plate for the side of a wagon body, substantially in the manner herein set forth."

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6. For a *Design for Spoon Handles;* Charles P. Gordon and George B. Gordon, Boston, Massachusetts, November 19.

Claim.—"What we claim as our invention, is the new and useful ornamental design or configuration, substantially as represented in fig. 1, and as herein before described."

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7. For a *Design for Stoves;* William B. Gleason, Boston, Massachusetts, assignor to James Hartshorn and Winslow Ames, Nashua, New Hampshire, November 26.

Claim.—"I claim the ornamental design or combination of the star, the fillet, the system of rays, the six torus arcs, and two straight connecting toruses, as disposed essentially as specified."

DECEMBER, 1850.

1. For an *Improvement in Machines for Turning Irregular Forms;* Smith Beers, Naugatuck, Connecticut, December 3.

"The general principles of this machine are similar to those of a machine invented in 1818, and known as the Waterburg last-making machine, but very differently arranged."

Claim.—"I do not claim the use of a pattern to govern the action of the cutters, nor do I claim the revolving cutters, nor the longitudinal vibration of the machine; but what I do claim as original, is the mode herein described of changing the position of the ratchet R by means of the arrangement of the sliding rod, knee lever, lifting plate, and pawl."

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2. For *Improvements in Machines for Boring Dovetailed Mortices;* Henry J. Betjemann, Cincinnati, Ohio, December 3.

"The object of my invention is to construct a joint for bedsteads which, without the faults of the screw, is equally capable of closely hugging the post as the strain is placed upon it. It also admits more readily of the use of a slat foundation, is durable, and little subject to injury, and very expeditiously put together or taken asunder."

Claim.—"What I claim as new, are, 1st, the rotating cutters, (*g h i k l,*) formed and arranged substantially as described, with conical heads and cylindrical necks, in combination with a rest or movable table, for the reception and attachment of the bed-post; the said table, while being advanced toward the cutters, being conducted by suitable guides, (*p p' p''*,) as described, either upon the moving table or the stationary bench, in a course which is at first at right angles to the face of the post, and thence, as soon as the cylindrical cutter (*l*) has begun to act in a longitudinal course, receding sufficiently from the face of the post to form a mortise which shall bind the dovetailed tenons of the rail as they are pressed down in their sockets.

"2d, In combination with the aforesaid guides, the stops, (*r,*) substantially as here arranged and applied, or their equivalents, whereby the table is limited in its course to the particular range of cutting action required for the time being."

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3. For *Improvements in the Alarm and Indicator for Steam Boilers;* Joseph Dilks, Philadelphia, Pennsylvania, December 3.

"My invention consists in attaching to a steam boiler of any of the known forms, a sliding valve and seat, worked by a float or ball; the said float rising or falling with the rise or fall of the water in the boiler, simultaneously acting upon the whistle and indicator."

Claim.—"I do no not claim to be the inventor of the float, valve, or steam whistle, the same being in common use; but what I do claim as my invention, is the peculiar method of moving the indicator by its attachment to the slide valve of the whistle, by which the connexion is continued through the head of the boiler, as herein described, dispensing with the stuffing-box and packing."

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4. For an *Improved Arrangement of the Bending Roller in Tin Cutting and Bending Machines;* William H. Horton, Newburyport, Massachusetts, December 3.

"The object of my improved machine is to reduce a piece of tin plate to a circular form, and at the same time, if necessary, to bend or turn down the edge of it at a right angle with the remainder, and thus to convert the said piece of tin plate into a box cover, or other article of similar character."

Claim.—"I claim to so combine and arrange the roller, Y, with respect to the jaws, E F, (as specified,) as to enable the said roller to be operated in the manner substantially as set forth; that is to say, to be moved in a plane parallel to the common axis of the shafts, C D; the said roller being arranged in a turning frame, Z, and supported by a movable and adjusting frame, A'; and the object of my improvement being to enable a person to move the roller against the tin in the manner and for the purpose of bending it down, substantially as herein before explained."

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5. For *Improvements in the Metallic Flask for Casting large Kettles,* William Kelly, Eddyville, Kentucky, December 3.

"My improvement consists in a certain construction of the iron flask in which are cast

kettles. Iron moulds are in general use for casting pans and kettles with the flanch upwards. I cast mine with the flanch downwards, and am thereby enabled to drive off the impurities contained in the iron, in the same manner as they are expelled from the iron in a brick mould."

Claim.—"What I claim as new and of my invention, is the elastic iron core, supporter, or inner part of the flask, constructed of wings attached to the crown, and provided with covering strips, substantially as described."

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6. For *Improvements in Machines for Dressing Spokes;* Orville Mather, Cincinnati, Ohio, December 3.

"It is aimed in this invention to combine with the dispatch and smoothness of finish of the planing action a sufficiently near approach for the purposes of the manufacture of spokes to the comprehensive capacities of the pattern turning lathe. This I accomplish by so constructing a planing apparatus; consisting of oppositely acting rotating cutters, that as the latter approach to or recede from the axis of the stuff, their cutting outline may be modified to suit the varying size and form of the work."

Claim.—"What I claim as new, is, 1st, constructing a cylindrically rotating cutter head, with a separating joint athwart its middle, and in the plane of its rotation, so arranged as that by the mutual advance or recession (in the direction of their axis of rotation) of the respective sections of the cutter heads as they traverse the length of the stuff, the cutting edges are adapted to impart the varying outline and form required for the work.

"2d, The shafts (9) and weighted levers (v' v') in combination with the levers (v'' v'',) and the links (w w,) or their equivalents, for sustaining in position the tongues (11) upon the spoke, and the rollers (r) upon the guides, and rendering the self-adjustable under all the circumstances which can effect them."

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7. For an *Improved Nail Plate Feeder and Turner;* Melville Otis, East Bridgewater, Massachusetts, December 3.

"The distinguishing characteristics of this machine are, 1st, the application of altering instruments to the nipper rod, which by friction turn it, and then leave it until the nail is cut off; and, 2d, the application of feeding instruments, which grasp the nipper rod and thereby thrust the nail plate between the knives of the nail machine, as above described, and when a nail is cut off, release the nipper rod from their grasp while it is turning; and, 3d, the nipper rod, the nippers, and nail plate are put into their places without being attached to any other instrument, and consequently nail machines may be more rapidly supplied with plates than by any other machine in use for the same purpose."

Claim.—"What I claim as my invention, is, 1st, giving the alternating motion to the nipper rod by means of a pair of jaws actuated by the opposite ends of a vibrating beam, one of the jaws being provided with a spring and toggle, which causes it to grasp and release the nipper rod—the whole operating substantially as described in the annexed specification and drawing.

"2d, I claim giving to the said rod its progressive advancing and slightly retrograde motions, by means of a pair of jaws actuated by a cam and an eccentric, and two springs, substantially as specified.

"3d, I claim operating the follower so that it is raised from the nail plate, and the nail plate from the lower cutting jaw of the machine, by means of a cam, a rock shaft, and a radius bar connected to one end of the follower, substantially as described.

"Lastly, I claim transmitting the motion from the nail machine to the feeding machine, by means of a lever beam and connecting rods, when the lever beam is hung upon a cranked centre, and the actuating connecting rod is provided with knob acting upon a flat crank pin, substantially as described in the annexed specification and drawings—whereby I am enabled with facility to throw my feeding machinery in and out of gear."

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8. For an *Improvement in Horse Rakes;* Harvey W. Sabin, Canandaigua, New York, December 3.

Claim.—"What I claim as my invention in my improved horse rake, is the device for raising the teeth simultaneously to clear them of the hay, and dropping them again, by means of the apparatus substantially as described, being worked by the draft of the team when thrown into gear, at the will of the operator."

9. For an *Improvement in Suspender Buckles;* Elisha Steele, Waterbury, Connecticut, December 3.

"The nature of my invention consists in constructing the tongue or point of the buckle to act and work as a slide in the inside of the buckle frame, instead of a hinge or roller, as in the ordinary buckle, so that upon drawing out the points or tongue and attaching the same to the web and applying the strain, the points slide back into the interior of the buckle, thereby firmly attaching the buckle to the web."

Claim.—"What I claim as my invention, is the construction of the buckle frame, and attaching the tongue or points thereto, so that the tongue or points slide out and into the buckle instead of acting upon a hinge or roller, as above described."

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10. For an *Improved Auger Handle;* Augustus Thayer, Malden Bridge, New York, December 3.

"The advantages of this handle above others now made I consider to be a combination of strength and simplicity. The fact that the principal part of the entire handle is in one piece from end to end, from *a* to *d* strengthened by a band of metal where the shank socket pierces it, instead of being divided into two parts near the centre, gives it great strength, and the operating parts are few, not liable to get out of repair, of common material, and cheaply made."

Claim.—"I claim the construction of auger handles substantially as set forth in the above specification; that is, by making the principal part of the same, from end to end, of one piece of wood or material, securing the central portion through which the auger shank passes with a metal band, and arranging a detent for holding the shank with machinery to operate it as exhibited in the drawings forming part of this specification—the said handles being for use with augers, or any other tools to which it may be adapted."

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11. For an *Improvement in Vulcanizing India Rubber;* Jonathan T. Trotter, City of New York, December 3.

"The nature of my invention consists in the new and useful manner in which I prepare the rubber, by means of an article or preparation of zinc.

"As a new and useful compound material for curing India rubber, it possesses many advantages over all other processes heretofore known or used. It has none of the taint nor offensiveness peculiar to sulphur-cured goods, nor the peculiarly objectionable characteristics of lead-cured goods, on account of their being black, or their liability to become so when exposed to the action of sulphuretted gases; but on the contrary, possesses a fine white (or nearly so) color, susceptible of being made up into all kinds of goods, and of variegated patterns, and under all circumstances from its almost inodorous flavor."

Claim.—"What I claim is, the use and employment of zinc prepared by the process above described, whereby a hyposulphite or similar preparation of zinc is obtained, in combination with India rubber, for the purpose of curing or vulcanizing it, substantially as hereinbefore set forth, without the use of free sulphur in any way, in combination with the rubber."

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12. For an *Improved Balance Boiler Feeder;* William D. Allen, Durhamville, New York, December 10.

"The nature of my improvement consists in having a hollow piston or plunger, divided in the centre by a partition forming two compartments or chambers, provided with apertures transversely through them, for receiving the water from the reservoir of supply, and discharging it into the boiler—said piston passing horizontally through the boiler on the designed water line, and working through short cylinders placed on opposite sides of the boiler, so that the piston shall work steam tight on both sides of the communications leading from the reservoir of supply through the cylinders. By this arrangement, *i. e.*, having the piston pass completely through the boiler, or separate in two pistons but connected in the centre of the boiler, and working from opposite sides of the same, I equalize the action of the steam in the boiler upon the piston, thereby overcoming a great obstacle in the way of a successful application of all self-supplying contrivances heretofore used."

Claim.—"What I claim as new, is having the piston B, with compartments and aper-

tures as described, passing completely through the boiler, and working in double packing boxes in short cylinders, *c c*, placed on opposite sides of the boiler, substantially as herein set forth."

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13. For an *Improvement in Buckles for Harness;* Solon Bingham, Jr., Poestenkill, New York, December 10.

"The peculiar advantage of this apparatus is, it avoids the constant wear and tendency to crack, occasioned in the use of the buckle by bending stiff leather round its rame, and in short turns, when shifting the tongue from hole to hole; also, the hold of the two studs is much stronger and less liable to tear out than is the buckle-tongue, and the lengthening or shortening the trace is done with much more ease and promptness than in the ordinary way."

Claim.—"I claim the construction of a trace clasp, as a substitute for a buckle for fastening together two straps of leather, by the use of a metal tongue fastened to one of the straps having projecting from it pins or studs, fitted to enter into holes to be made therefor in the other strap, the tongue and strap lying one against and upon or near the other; the tongue and strap to be kept in this juxtaposition by a slide or box enclosing them—the whole substantially as set forth in this specification."'

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14. For an *Improvement in Bearings for Axles and Shafts;* William H. Hovey, Hartford, Connecticut, December 10.

"The nature of my improvement consists in the application to the back end of the box of a plate of metal which fits over its sides, and is capable of sliding up or down upon it; on the inner side of this plate is a conical recess, which holds a conical metal packing ring, and by means of the bolts which hold the plate to the box, forces the face of the said packing ring up to the outside of the box, and causes it to embrace the axle, so that the lubricating material in the box is confined therein, and dust, dirt, &c., excluded from the journal."

Claim.—"I claim the combination of the sliding plate E, having a conical seal *a*, and the conical packing ring F, applied and secured to the journal-box of a car or other axle, or of a machine shaft, in the manner substantially as herein described, for the purposes set forth."

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15. For an *Improvement in Lever Jacks;* James Leffel, Springfield, Ohio, December 10.

"In my improved jack the power is applied to a lever, which acts upon a toothed sliding bar; the latter, when moved by the lever, is prevented from returning by a spring click or pall, which can be connected with or disconnected from the lever at will, to enable the operator either to lower the weight, which is supported by the sliding bar, tooth by tooth, or to raise it in like manner.

"It possesses an advantage over all lever jacks hitherto devised in allowing of the lowering of the sliding bar, tooth by tooth, without disengaging the click by hand, as its lever, when connected with the click, as herein set forth, effects the double purpose of lowering the bar and disengaging the click."

Claim.—"I claim the hanging of the lever by links, which permit the lever teeth to disengage themselves from those of the rack bar, with which they are engaged by simply raising the lever, and allow them to re-engage with a new set of teeth when the lever is depressed, substantially as herein set forth.

"I also claim the method of connecting the pawl with the lever, in such manner that by simply working the latter, the rack bar, with the weight resting thereon, may be lowered, tooth by tooth, substantially as herein set forth."

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16. For an *Improvement in Electrotyping;* George Mathiot, City of Washington, D. C., December 10.

"It is well known that in copying engraved plates by the electrotype, the deposit is apt to adhere so firmly to the original or mould as to resist every attempt to separate them; the engraved plate being thereby destroyed. I prevent this destructive adhesion by making the plate to be copied chemically clean, and then expose it to the action of a halogen element or compound. And I further expose the plate so acted on to the action of a strong light for several hours before introducing it into the electrotyping apparatus."

Claim.—"I do not claim to cover the face of the plate with heterogoneous matters, as air, smoke, wax, oil, &c., for the purpose of preventing adhesion; but I claim to form a heterogeneous substance on the surface of the metallic plate by exposing it to the action of iodine, bromine, chlorine, or other chemicals capable of forming an insoluble compound with the metal, for the purpose herein set forth.

"I also claim to expose the metallic plate to the action of light after being acted on by a halogen element, substantially for the purpose of preventing the adhesion of the deposit, as specified.

"I claim the use of iodine in the electrotype process, in the manner herein subtantially set forth, and for the purpose specified."

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17. For an *Improvement in Seed Planters;* Samuel Pennock and Morton Pennock, Kennett Square, Pennsylvania, December 10.

"The nature of our improvement consists in making the drill tube of a peculiar form, adapting the front for the reception of adjusting and changeable points; having the heel open to prevent clogging, and for other purposes; making the changeable point of a peculiar form; attaching the drill tube to the drag bar, without the use of any kind of tool or separate fastening."

Claim.—"What we claim as new, is the combination with the depositing tube, and the bar which connects said tube with the body of the machine, the joint *m n*, as above described—said joint being of such peculiar construction as to be complete and effective in itself, without any movable device whatever, and which admits of attaching or detaching said tube at pleasure, without the use of any kind of implement or tool, or separate connecting bolt or fastening, as before described."

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18. For an *Improvement in Seed Planters;* Dexter B. Rhodes, Concord, New York, December 10.

"The nature of my improvement consists, 1st, in having two sliding bottoms to each hopper, one of which measures the quantity of seed, and the other discharges it into the hills; also, in having one side of each hopper, through which the under bottom slides, adjustable, so as to regulate the capacity of the seed cell. 2d, In having the hoppers attached to, or setting in adjustable frames, which slide laterally on the top of the carriage frame, for the purpose of regulating the distance between the hills as hereafter more fully described."

Claim—"What I claim as new, is the upper and lower sliding bottoms, *n n* and *l l*, in combination with the adjustable side of the hoppers *r r*, operating in the manner and for the purpose substantially as herein described."

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19. For *Improvements in Sewing Machines;* Frederick R. Robinson, Boston, Massachusetts, December 10.

"The object of my invention is to produce either what is generally termed stich and back-stitch sewing, or ordinary stitching. By "ordinary stitch and back-stitch" sewing I mean that in which a thread, after being carried through a piece of cloth, from its front to its rear side, is moved backwards the width of the stitch, is next again carried through from the rear side to the front side of the cloth, is next carried forwards laterally double the width of the stitch, or some other suitable distance greater than the width of the stitch, and is next passed through the cloth from its front side to its rear side; such operation being successively repeated in the formation of the stitches. By 'ordinary stitching' I mean that in 'which a thread is passed through the cloth from its front side to its rear side, is next moved forwards the width of the stitch, is carried backwards through the cloth from its rear side to its front side, is next carried forwards the width of the stitch, and is again passed through the cloth from its front side to its rear side, and so on. This is frequently called the running or basting stitch."

Claim.—"What I claim as my invention, is the combination of two needles, two thread guides, and a cloth holder, made to operate together, substantially in the manner and for the purpose as herein before set forth.

"And I also claim the improvement of making the needles with springs, and applying mouth pieces or pressers to them, and on each side of the flanch of the base plate, the whole being substantially as above described."

20. For *Improvements in the Manufacture of two and three ply Carpets;* Alexander Smith, West Farms, New York, December 10.

"My invention consists in weaving two and three ply ingrain carpets by the combination of parti-colored warp and weft, arranged so as to cause the warp and weft to unite in forming the same color in the figure as produced by the jacquard or any other mechanical means by which any variety of colors or shades on one or more plies that may be desired may be produced in the same range, in the direction both of the warp and the weft, the figure being formed by throwing down the weft, which obviates any difficulties arising from imperfections in the parti-coloring of the yarn."

Claim.—"What I claim as my invention in the weaving of two or three ply ingrain carpets, is the employment of parti-colored warp and weft, operated by the jacquard or other mechanical means to form the figure, when the same colors in the warp and in the weft are caused to combine together to form the same colored figure in the fabric, substantially as described.

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21. For an *Apparatus attached to Vessels for Indicating the Depth of Water;* Henry B. Sommers, Ithica, New York, December 10.

Claim.—"What I claim as my invention, is the combination of a sounding chain or jointed rod with an indicator on the deck of a vessel, operated by means of a cord, pulley, or other equivalents, so as to indicate the depth of water whilst the boat is making headway, as herein described and represented."

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22. For an *Improvement in Planing Machines;* Daniel H. Southworth, City of New York, December 10.

"My invention mainly consists in so attaching a narrow circular saw-blade to a strong, firm, and steady cast or wrought iron planing wheel, to contain planing cutters, that the saw may be stiffened and rendered free from trembling, shaking, or running in, and made to cut in advance of the planing cutters, to level and cleanse the surface of the plank or timber, so that the planing cutters may with facility produce an extra smooth surface; and in clearing cutters being so arranged and adjusted as to immediately follow the saw, being attached to the wheel, near the periphery, on the rear or slab side thereof, and cut and clear away any timber or slab which may be left to pass back of the saw and on the rear or slab side of the same and of the wheel."

Claim.—"I do not claim as any part of my invention a planing wheel, or planing or clearing cutters; nor do I claim the combining of a circular saw with a planing wheel, by uniting two circular saw plates, and attaching planing knives thereto, as these have been known and used before; but what I do claim as my inventiou, are the following new and useful improvements by way of new attachments and combinations.

"1st, The attachment, either whole or in segments, of a narrow circular saw-blade to the front of the periphery of an iron or other metallic planing wheel, (properly counter sunk for the purpose,) in combination with the clearing and planing cutters, so that the saw shall be stiffened and rendered free from trembling, shaking, or running in, and made to cut in advance of the planing cutters to cleanse and level the surface of the plank or timber, that the planing cutters may with facility produce an extra smooth surface, and be cleared of timber or slab by the clearing cutters, as set forth;—the attachment of the saw-blade to the wheel being such, by screws or otherwise, that the saw-blade may be easily removed or taken off, for the purpose of turning the reverse face to the plank or timber, whenever the teeth on one side have become worn, dulled, or out of set from long usage against the timber.

"2d, The clearing cutters *n n n*, in combination with the saw and planing wheels, arranged in the manner and for the purposes herein set forth, the whole being arranged in the manner and for the purposes herein set forth and described."

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23. For an *Improvement in Elevating, Cooling, and Conveying Flour;* Jesse White and Jonathan Bundy, Barnesville, Ohio, December 10.

"Our invention consists in effecting any one or all the operations of elevating, conveying, and cleaning grain, and of elevating, conveying, and cooling flour and meal, by means of a current of air produced artificially, with sufficient velocity to carry the grain or flour along with it through the tube, or other channel through which it is forced."

Claim.—"What we claim as our invention, is the method of elevating, conveying, and cooling flour or meal by passing it, by means of a blast, through an air trunk and head, constructed substantially as herein set forth."

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24. For *Improvements in Machines for Making Pill Boxes;* Nelson D. White, Winchendon, Massachusetts, December 10.

Claim.—"What I claim as my invention, is the contrivance for supporting the stick, and feeding each stick forward towards the cutters, the same consisting of the saddle and orifice, (applied to the rotary block holder,) the endless screw D, the shaft E, the spring G, the bearing plate *g*, fixed to the shaft B, the pinion H, and the stationary gear wheel I—the whole being applied and made to operate together, substantially in the manner as above set forth.

"I do not claim the employment of a circular saw for the purpose of separating portions of the sticks; but what I claim as my invention or improvement, is the combination of said saw with the rotating series of sticks, or their rotating holding frame, substantially in the manner and so that they shall be successively operated upon by it as specified."

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25. For an *Improved Cut-off Motion for Puppet Valves;* Samuel H. Gilman, Cincinnati, Ohio, December 10.

"The nature of my invention consists in a provision for cutting off, at any desired point, the supply of steam to the cylinder when drop valves are used, by making the lifters vibratable upon the rock shaft, and causing them to act in obedience to the motions of gravitating toggles, which being trippled by impact with an adjustable stop, allow the lifter to rotate upon the shaft, and the valve to descend.

"This invention is shown as applied to the supply valve of an oscillating engine, the steam chest of which is upon the trunnion sides, the trunnion making part of the supply passage, and being cast in one piece with the front of the steam chest."

Claim.—"What I claim as new, is, 1st, raising and dropping at any desired point the puppet valves that admit steam to the cylinder, by means of a lifter that vibrates with and upon the usual rock shaft, the said lifter being operated by a gravitating and counter-balancing toggle, as described, so that the lifter, in the manner described, or its equivalent, is fixed for raising the valve, and is depressed and allowed gradually and easily to drop the valve when the counter-balance of the toggle is operated by the adjustable stop, substantially as herein described."

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26. For an *Improvement in Seed Planters;* John Signer and Thomas N. Shipton, Kishacoquillas Valley, Pennsylvania, December 10.

Claim.—"What we claim as new and of our own invention, is dividing the drill teeth or depositing tubes into two separate sections G H, and hinging or connecting the two sections at their upper ends, in such a manner as to permit the longest or rear section H, to recede or turn on its connecting pins, (*a*,) while the upper or short section retains its proper position in relation to the drag bar and flexible conducting tube, and providing the upper or short section G with two arms, J J, having notches therein, which, when the two sections of the drill tooth are closed, becomes coincident with a notch formed in an arm, K, projecting from the rear or longest section H, into which is inserted a wooden pin, which it is intended shall break when the rear or longest section of the drill tooth shall strike against a rock or other obstruction and thus separate the sections, and permit the longest section H, to recede and clear itself from the obstruction, whilst the flexible conducting tube is held in its proper position by an oval loop on the inside of the section G, as herein fully set forth and represented.

"2d, We also claim providing the clutch plate R, with an additional row of teeth (*l*,) adjacent to the side beam of the frame for engaging with a tooth, T, projecting therefrom, for arresting the motion of the seeding rollers simultaneously with unlocking the axle from the propelling wheel, and thus stop the operation of the machine, as fully set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

Remarks Suggested by an Examination of the Recent Statistics of the Cotton Manufacture in Great Britain. By MR. G. R. PORTER.*

The fear of being dependent upon foreign countries for the supply of any article of first necessity has often influenced the mind of the public, although the cases can be but very few in which that fear can have any just foundation. It must be evident, upon the slightest reflection, that if the industry and capital of any country have been applied to the production of any article, the market for which is habitually found in some other country, it must be at least as disastrous for the producing country to be deprived of its market as it could possibly be for the consuming country to have its supplies cut off. In point of fact, both countries would necessarily be placed by the interruption in the same condition of distress, since, to be in a condition to deal together, both must be producing and both consuming countries. There are circumstances, however, under which it might be unwise for a country to be willingly dependent upon another for the means of setting its industry in motion, viz., when the causes of the interruption that will operate injuriously are beyond the control of the country of supply; and such a case actually exists in respect of the, to us, all-important article, cotton. Our supply of cotton has hitherto been drawn in very fluctuating proportions from British India, Brazil, Egypt, our West India Colonies, and the United States of America. From this last-named country the quantities were for a long series of years in a continual condition of increase. From Brazil our importations have sensibly lessened without any reasonable prospect of future increase. From Egypt the quantities fluctuate violently, and depend greatly upon causes not falling within ordinary commercial considerations. In the British West Indies the cultivation of cotton has for some time ceased to form a regular branch of industry, and it is hardly to be expected that having thus ceased to be profitable when prices in Europe were uniformly at a higher level than they have been for now a long series of years, the cultivation of cotton to any important extent will be resumed in these colonies. From British India the quantities received depend upon a different set of circumstances, but of such a nature as to forbid any very sanguine hope of great and permanent increase in the shipments. To those who reflect seriously upon these facts, it must appear a matter of grave importance how any continued failure of cotton crops is to be met; and not only so, but also, how a substitute is to be found for the hitherto constantly increasing amount of those crops; for it will not be enough to provide the same amount of employment as before for our continually growing numbers in a branch of industry which, by its ordinary operations, necessarily brings forward those increased numbers. The uneasiness which it is natural to feel under the circumstances here described, has led to the inquiry, as diligently and as carefully as opportunity has allowed, whether some substitute or auxiliary may not be called into action which shall meet the evil that threatens us; and this,

* From the London Athenæum, August, 1850.

it is suggested, may be found in a kindred branch of manufacture—that of flax. A very few years ago, when first anxiety began to arise concerning the prospects of our cotton manufacture, the resource which has just been named did not present itself. At that time, our linen manufacture had not made the progress by which it is at present marked—a progress proportionally equal to any that has been made at any time in the cotton manufacture. Hitherto we have, in this kingdom, been greatly dependent upon our foreign importations for supplies of flax; and while the law imposed restrictions upon the importation of grain for human food, there existed a kind of moral impediment in the way of increasing our home growth of articles for any purpose not of equal primary necessity. That impediment is now removed; and there can be no reason given why our fields should not be henceforth used for the production of any article that promises an adequate profit to the farmer. It is especially desirable so to apply the productive power of the soil for the supply of articles as indispensable to the support of millions of people as corn itself; and an additional inducement to the growth of flax beyond that offered by other articles, may be found in the fact that to bring it to the same condition as that in which it is usually imported from foreign countries, calls for the employment of a considerable amount of human labour. There is no part of the United Kingdom in which the flax plant cannot successfully be cultivated; and there is hardly any country where it might not be brought to supply our deficiencies, should such arise. It should not in any degree interfere with the prosperity of the present race of cotton manufacturers if flax were to be substituted in part for the material now employed by them. Some changes are doubtless necessary in order to adapt their present machinery for the spinning of flax, but not to any important extent; and the expense to which the proprietors might thus be subjected would be well compensated during the first year of short supply of cotton that might arise, by the security that they would feel in the future regularity of their operations; assured as they then would be against the irregularity of seasons, or those disturbances which have arisen, and which always may arise, to disarrange their operations and to interfere with the regular employment of their hands. It would not appear difficult so to order the arrangements of a spinning-wheel or a weaving shed that both flax and cotton might be included within its operations, and that the preponderance in those operations might be giving from time to time either to the one or to the other, according to the capabilities of the markets of supply on the one hand, and the requirements of the markets of consumption on the other.

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*The Present System of Steamboat Inspection—Explosion of the Boiler of the "Queen" Steamer.**

On Wednesday, July 10th, a fatal explosion occurred at Devonport, on board the steamer, *Queen*, the boiler of which burst just as she was coming from her night moorings to the Quay, for the purpose of taking on board a large party who, in a few moments more, would have been all on board.

* From the London Artizan, for November, 1850.

Upon an examination of the boiler, immediately afterwards, it was found to have been driven forward about 2 feet from its former position, and the back plates had been entirely removed; and so great had been the amount of force exerted on it that it was completely torn off, the line of separation being through the centre of the angle iron which connected the sides, bottom, and top of the boiler to the back, which had now been blown overboard. The area of the open end was found on measurement to be about 40 square feet, or about 8 feet by 5 feet. The tubes, which were of iron, and about 2½ inches diameter, were covered with a slight incrustation, or scale, and on examining the top ones, no indication of their being left dry for want of water was to be found, as there was no sign of recent oxidation, and the scale was adhering to the top of them as firmly as on any of the surrounding parts of the boiler. On the back of the fire-box, between which and the back there had been a water space of between 4 and 5 inches, were two angle iron stays of about 3 inches wide, and 12 inches long, fastened to the plates with ¾ inch rivets, with three holes ¾ inch diameter, to connect with similar pieces riveted to the back of the boiler, by means of cotter pins, each overlapping the other; one of the stays was split through these pin holes from top to bottom, and on the fractured surface there was an amount of incrustation about equal to that on the surrounding parts, indicating that the stay had been in that state for some considerable time, and of course was of *no use* as a stay; the other stay, situated in a similar position on the back of the fire-box, was of the same general dimensions, but entire, with two of the three connecting pins in their places; clearly showing that its fellow stay connected to the missing back must be split also, which, upon subsequent examination, was found to be the case, and which also, from the amount of scale on the fractured surface, proved that it had been long useless. The distance horizontally between the two stays was about 28 inches; there were no stays to the bottom of the boiler, to connect it with any other portion. There were six diagonal stays of about 1½ inches round iron, connecting the bottom of the steam-chest with the sides of the boiler, which merely prevented the angle at the top of the sides being distorted by the upward and lateral pressures, the bottom and back being unsupported at the time. We should suppose that the first part to give away under these circumstances would be the junction of the bottom and back, in the centre of their length, as the two forces acting downward and backward would resolve themselves into one great force on that particular spot; and so it evidently had been, for the middle of the back edge of the boiler bottom was bent down about 3 or 4 inches, leaving two legs of flat iron which had been fastened to the bottom of the fire-box for support, about that much clear of the bottom of the boiler, and the bottom edge of the back part, when found at low water, was bent backward in the middle in a similar manner, and presented every indication of having been the first point to give way.

Upon a subsequent examination of the safety valve, it was found that there was insufficient space for the escape of steam from it, *by the box above the valve being nearly filled with the lead weight on the spindle*, the area of which space was only about ⅓ the area of the valve itself. There was nothing which indicated a *sticking* of the valve at the time of the explosion.

In addition to the weight on the spindle in the valve-box, there was a lever resting on the top of the spindle outside, with a shifting weight on it; this lever was accessible to the engineer, and by it he could vary his pressure to the extent of some 4 or 5 pounds per square inch on the valve. Upon weighing the weights, valve, lever, &c., it was found that the whole weight on the valve was about 253 lbs; area of valve 15 inches; which would give as a maximum pressure as follows:

$$\text{Whole weight, } \cdots = 253 \text{ lbs.}$$

$$\frac{\text{Whole weight}}{\text{Area of safety valve}} = 16\tfrac{13}{15} \text{ lbs. per square inch.}$$

$$\text{Area of safety valve, } = 15 \text{ ins.}$$

But at the time of the explosion the weight on the lever was not at its maximum, but giving a pressure of 15·15 lbs. per square inch, and it appears in the evidence before the coroner, that the person in charge of the engines at the time was on deck about three minutes before the explosion, and the steam was *not quite up*. This would lead us to suppose that the back of the boiler was in a very weakened state, produced by the continual warping or bulging out and in, as the steam might be up or down, until it had destroyed, to a very serious extent, the cohesive power of the angle iron, and that power had become less than was necessary to withstand the force of the accumulated pressure of the steam. The back of the boiler being at the time unsupported by stays, which, on account of their mal-construction, had long before been rendered useless, was from its shape the weakest part, and gave way accordingly.

There appears to have been a very lamentable amount of ignorance, or negligence, perhaps both, displayed in this affair. Ignorance on the part of the designer or constructor of the boiler, clearly shown in the character and extent of the stays; and negligence on the part of the inspector, who had inspected and given a certificate, only 30 days prior to the occurence, although, as shown on the inquest, he knew there was *no mercury in the steam guage;* or on the part of the proprietors, or persons in charge of the engines and boiler. One or more of three parties are highly culpable. But since the passing of the Act 9th and 10th Vict., *legal* responsibility is removed from the shoulders of steam-boat proprietors, as long as they get their boats and engines *legally* inspected at the appointed times, and it is hardly to be expected that persons who are not thoroughly acquanted with the internal structure and general principles of steam engines and boilers, will think there is anything materially wrong so soon after the inspection, especially in this case, where the boiler was only thirteen months old.

We must be allowed to think that the extent of the inspection is too limited. The inspector should not only examine the general structure of the engines and boiler, but he should also be empowered to try in his balance the capabilities of the person in charge, and search him as to his knowledge of the machine he professes to be master of. We hesitate not to say, that in many instances we have found persons in charge of marine and other engines who are not fit for the positions they fill. But when we say that those persons should undergo the examination of the inspector, we mean of course that the inspector shall be a person who understands his business thoroughly,—a man acquainted with the practical working of steam machinery; and when he makes an official inspection of engines or

their boilers he shall personally examine such portions as are likely, by failure, to jeopardize human life; or if not personally, his proxy shall be accountable for the truth or genuineness of his report.

There is an important fact connected with this affair; for, says the Mining Journal, "*The maker of the boiler was the government inspector, and in giving his evidence, (at the inquest, we presume,) he manifests a degree of subserviency to the opinions of the owners, which is too likely to exist when the interest of the employer is submitted to the tribunal of the judgment of the employed.*" And from the evidence of Mr. Simpson, "it appears that it was not usual for the inspectors to make an internal examination of the boilers." If this be the truth, what guarantee have the public against a repetition of such calamitous results, and to what an extent may we not suffer from this fact? Before the passing of the 9th and 10th Vict. steam-boat proprietors were in the habit of employing some one capable of making an examination of the state of their machinery, and of reporting thereon; especially if it were supposed that things were not right, or as they should be; but now, as before stated, the responsibility is taken from their shoulders, and a *legal* inspection, followed by a certificate, is reckoned a sufficient security against immediate danger. But the case of the *Queen* proves that, however good the provision may be, taken on its merits, the working in detail is not in a healthy state. For here was a boiler which was inspected, and certified to be in a safe condition and good working order, whilst it is proved that such was not the case, and it is known that that part of the boiler which gave way was not examined. Indeed, were those very stays in as perfect a state as good materials could make them, the boiler was not a safe one; for, in the first place, there were not a sufficient number of stays, there being none in the boiler bottom to stay *it* to any other portion, neither were there any to the top of the furnaces, or across the boiler, and the only two stays on the back, although of a flat form and very extensive area, were made of angle iron, and so fixed as to present but little resistance in the direction of the force exerted on them with the steam up. The only mystery is that the accident did not happen sooner; only the very best of materials could have prevented it.

We hear that the boiler is now in the hands of her original maker for thorough repair, and will now have *plenty* of stays of the proper shape, upon the principle, that if two are not enough, four may be.

These facts, added to some other similar accidents that have occurred lately, seem to indicate that the system of the inspection of steam machinery is not so efficient as it ought to be, and that some change in its enactments is needed. A most important point, and one that has been most strangely overlooked by the legislature, is the obtaining the services of engineers, whose business engagements are not likely to interfere with their duties as inspectors. Under the present system a foreman or manager may be called upon to inspect a boiler made by his employers; or, what is scarcely less objectionable, by some competing firm. No honest man would wish to be placed in such a position, whilst, at the same time, it unfortunately happens that there are but few competent practical engineers to whom the objection does not apply. This may arise from the low scale of fees payable to the inspector, which render some other source of income ne-

cessary, in all but one or two of the largest ports. The only way in which this difficulty could be overcome, would be to diminish the number of inspectors, and unite several ports under one supervision. This would have the effect of raising the remuneration and position of the inspector, and of rendering him independent of patronage. Our experience does not lead us to anticipate that any step will be taken in the matter, until the public have been startled by some very glaring case, when we may probably have to report on the grand discovery that will then be made of the inefficiency of the present system.

We should add that at the time of the explosion one of the stokers was killed, another man had his leg broken, and a third, who was the engineer and part-owner, was so severely scalded that he died, after lingering about three weeks.

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*Telegraphs in Germany.**

Within the last four months, through the activity of the minister of trade, no less than 1000 miles of telegraph have been opened in Austria, making the total mileage about 2000, of which about one-quarter has the wires laid underground on the improved system. Another 1000 miles will be ready by next year. The telegraph now works from Cracow to Trieste, 700 miles. On the 1st October the new telegraph union between Austria, Prussia, Saxony, and Bavaria comes into operation under a uniform tariff, which is one-half of the former charges. The progress will be looked upon with interest by the commercial public here, who are very much in want of facilities corresponding to those enjoyed in the United States, and at the same charges.

Translated for the Journal of the Franklin Institute.

Journal of the Æronautic Ascension of MM. Barral *and* Bixio, *made at Paris 27th July*, 1850.

This excursion of MM. Barral and Bixio must not be confounded with the ordinary balloon ascensions for the purpose of making the public stare, and gaining money, but was an excursion undertaken by two hardy natural philosophers, for the purpose of solving experimentally certain atmospheric problems, as yet undetermined. Their first excursion, undertaken under the most unfavorable circumstances, was a failure; the second, the journal of which we give below from the proceedings of the Academy of Sciences of Paris, was more successful, although the travelers did not get up as high as they wished; and we understand that they are now busily engaged in preparing a third, for which we hope and expect a still more entire success. The following is the report by them to the Academy:

"The principal questions upon which our attention was to be fixed during our second ærial journey, were the following:

* From the London Mining Journal, No. 787.

"1st, The law of decrease of atmospheric temperature with the height;

"2d, The influence of the solar radiation in the different regions of the atmosphere, deduced from observations made upon thermometers whose reservoirs were endowed with very different absorbing powers.

"3d, The determination of the hygrometric state of the air in the various atmospheric strata, and the comparison of the indications of the psychrometer with the dew point at very low temperatures;

"4th, Analysis of the atmospheric air at different heights;

"5th, Determination of the quantity of carbonic acid contained in the high regions of the atmosphere;

"6th, Examination of the polarization of light by the clouds;

"7th, Observation of the various optical phenomena produced by the clouds.

"The apparatus placed at our disposal were :

"1st, Two syphon barometers, graduated on the glass, whose upper meniscus we were to observe; the position of the lower meniscus being given by a table constructed from direct observations made in the laboratory. Each of these barometers is provided with a thermometer divided into centesimal degrees.

"2d, Three thermometers, with arbitrary scales fixed at a distance of 5 centimetres (2 inches) from a metallic plate. The reservoir of the first of these thermometers has a surface of glass; the surface of the second is coated with lamp-black, and that of the third is covered by a cylinder of polished silver, which also envelopes a part of the stem. The reservoirs are cylinders, narrow but very long. Immediately below the reservoirs the metallic plate carries a silvered plate very highly polished. The plate, with its thermometers, is placed horizontally on one of the sides of the car, so as to remain constantly exposed to the solar radiation.

"3d, A vertical thermometer, with an arbitrary scale, whose cylindrical reservoir is placed in the axis of several concentric envelopes of highly polished tinned iron, open below to permit the circulation of air. This disposition was arranged to obtain, at least approximately, the temperature which a thermometer in the shade would give.

"4th, A psychrometer formed by two thermometers, with arbitrary scales.

"5th, A condensing hydrometer on M. Regnault's plan.

"6th, Tubes with caustic potassa, and pumice soaked with sulphuric acid, for the determination of the carbonic acid of the air. The aspiration of the air was to be produced by a pump of a capacity of 1 litre, and exactly guaged.

"7th, Two glass globes of 1 litre capacity, provided with steel stopcocks, and intended to collect the air in the high regions. These globes, which were placed in tin cases, had been carefully exhausted of air before our departure.

"8th, A Walferdin minimum thermometer. This thermometer, graduated by M. Walferdin, is enclosed in a tin cylinder, pierced with holes. At our request, this apparatus was placed under seal.

"9th, An apparatus furnished by M. Regnault, and intended to indi-

cate the maximum elevation which the balloon had reached. This apparatus was enclosed in a tin case pierced with a great number of holes. The cover of the case was also sealed.

"10 h, An Arago Polariscope.

"The instruments with scales were made by M. Fastré, under the direction of M. Regnault. The tables for the graduation were calculated in the laboratory of the College of France, and were known to M. Regnault alone.

"The balloon is that of M. Dupuis-Velcourt, which had served for our first ascension, but the lower orifice terminates in a cylindrical tube of silk of 7 metres (22·96 feet) in length, which remained open to allow the gas to escape freely during the ascent. The car was hung about 4 metres (13·12 feet) below the orifice of the silk tube. The instruments were hung around a large ring of sheet iron, which was attached to the usual wooden hoop which carries the cords of the car. The form of this ring is such that the instruments were placed at the proper distance from the observers.

"The plan was to ascend about 10 o'clock, A. M.; all the arrangements were taken to have the filling of the balloon begun at 6 o'clock. This operation was confided to MM. Veron and Fontaine.

"Unfortunately, circumstances beyond our control caused injurious delays, and the balloon was not ready until 1 o'clock. The sky, which until noon had been very clear, was covered with clouds, and very soon rain fell in torrents on Paris. The rain did not cease until 3 o'clock. The day was too far advanced, and the atmospheric circumstances were too unfavorable for us to hope to fulfil the proposed programme. But the ærostat was ready, great expenses had been incurred, and observations in such a disturbed atmosphere might lead to useful results. Our departure took plack at 4 o'clock; it presented some difficulties in consequence of the very limited space which the garden of the observatory afforded for the operation.

"One of the barometers was broken and left behind. The same accident happened to the thermometer with blackened bulb.

"We here transcribe the notes which we took during our ascent:

"4h. 3m. Departure. The balloon rises at first very slowly, moving towards the east; after throwing out several kilogrammes of ballast, it takes a more rapid ascensional movement. The sky is completely covered with clouds, and we soon find ourselves in a light haze.

"4h. 6m.	Barometer	694·70	mm.	attached thermometer	+16°	C.	Height=757 metres.
"4h. 8m.	"	674·96	"	"	16	"	999
"4h. 9m. 30sec.	"	655·57	"	"	13	"	1244
"4h. 11m.	"	636·68	"	"	9·8	"	1483*

*All the barometric heights given have been reduced to the temperature 0° by calculation. By means of the barometric and thermometric observations made at the observatory and in the car, the heights of 19 stations above the observatory, and above the sea by adding 65 metres to them, were calculated. But the three heights, 6512, 7016, and 6765 metres, where the temperature had fallen to —35° and —39° were obtained by comparison, not with the observatory, but with the intermediate station, 5902 metres, where the temperature was —9·8°, and the pressure 367·04mm. We thus find 7004 metres for the highest station. But there must still be added a correction of 12 metres due to the height, 5902 metres, of the lower station compared, which makes in all 7016 metres, (23018·33 feet, or 4·36 miles). This is exactly the height reached by Gay-Lussac and Biot.

"Above us a continuous mass of clouds; below us, detached clouds, which seem to roll towards Paris. We feel a fresh breeze.

"4h. 13m. Barometer 597·73 mm. attached thermometer +9·° C. Height 2013 metres.
"4h. 15m. " 558·70 " " 9· " 2567
"4h. 20m. " 482·20 " " —0·5 " 3751

"The cloud into which we are penetrating presents the appearance of a common very thick fog: we no longer see the earth.

"Barometer 405·41 mm. attached thermometer —7°. Height 5121 metres.

"Some rays of the sun become perceptible through the clouds.

"The barometer oscillates between 366·99 and 386·42; the thermometer —9°; height from 5911 to 5492 metres.

"The balloon is completely distended; the tube appended, which up to this time had remained flattened under the pressure of the atmosphere, is now distended, and the gas escapes by its lower orifice, as a whitish streak; we perceive its odor very distinctly. A tear is found in the balloon at the distance of 1·5 metres from the origin of the tube. A clearer space shows itself, and allows the position of the sun to be vaguely seen.

"After again throwing over some ballast, the balloon resumes its ascent.

"4h. 25m. Barometer oscillates from 347·75 mm. to 367·04; thermometer —10·°5 to —98·°; Height 6330 —5902 metres.

"The mist, much less intense, allows a white and feeble image of the sun to be seen. Barometer oscillating. We are covered with little icicles in extremely fine needles, which collect in the folds of our clothes. During the descending period of the barometric oscillation, that is, during the ascending motion of the balloon, the note-book opened before us receives them so that they appear to fall upon it with a kind of crepitation. Nothing similar shows itself during the ascending period of the barometer, that is during the descent of the ærostat.

"The horizontal thermometer with glass bulb gives —4·°69.
" " " silvered " " —8·°95.

"We see distinctly the disk of the sun through the frozen fog, but at the same time, *in the same vertical plane, we see a second image of the sun nearly as intense as the first; the two images appear symmetrically placed above and below the horizontal plane of the car, each making an angle of about* 30° *with this plane.* This phenomenon was seen for more than 10 minutes.

"The temperature falls very rapidly; we attempt to make a complete series of observations upon the thermometer for radiation, and on the thermometers of the psychrometer, but the mercurial columns are hidden by the corks, because so sudden a fall of the temperature had not been foreseen. The thermometer with the coverings of tin plate gives —23·°79.

"4h. 32m. The clouds separate above us, and we see a place in the sky of a light azure blue, like that which on a clear day is seen from the earth. The polariscope shows no polarization in any direction on the clouds, in contact with us, or farther off. The sky-blue is, on the con-

trary, strongly polarized. Barometer oscillates. Ballast thrown out, by which a new ascending movement is obtained.

"4h. 45m. Barometer 338·05 mm. attached thermometer —35°. Height=6512 metres.

"Our fingers are stiffened with the cold, but we experience no pain in the ears, and the respiration is not at all obstructed. The sky is again covered with clouds, but the clouded sun and its image are still visible. We throw out ballast, which gives a new ascent.

"4h. 50m. Barometer 315·02. The extremity of the attached thermometer is about 2° below the lowest division traced on the instrument. This division is —37°; the temperature was then about —39°; height 7016 metres.

"The barometer oscillates from 315·02 to 326·20; thus the ærostat oscillates from 7016 to 6765 metres. We have but 4 kilogrammes of ballast left, which we deem prudent to keep for our descent. We hoped to keep ourselves for some time at this height, but although the silk tube was raised up to avoid the exit of gas from its orifice, the balloon begins its descent. We take the air for examination. The tube of one of the globes is broken by the efforts made by us to turn the stop-cock. The second is filled with air without accident.

"5h. 2m. Barometer 436·4; temperature —9°. Height 4502 metres.

"We again meet the little needles of ice.

"5h. 07m.	Barometer	483·16.	temperature	—7°.	Height 3688 metres.
"5h. 10m.	"	540·39.	"	—3°.	" 2796
"5h. 12m.	"	559·70.	"	—1°.	" 2452
"5h. 14m.	"	582·90.	"	0°.	" 2185
"5h. 16m.	"	598·5 to 618	"	+1·°8	" 1973 to 1707

"These oscillations were produced by the last portions of our ballast which we threw out. We think of nothing but moderating our descent by sacrificing every thing disposable except the instruments, and we put the thermometers in their cases.

"5h. 30m. Reached the earth, at the hamlet des Peux; commune de Saint Denis-les-Rebais; arrondissement de Coulommiers, (Seine et Marne,) a short distance from the residence of M. Brulfert, the Mayor of this commune, situated 70 kilometres (43½ miles) from Paris. We were so fortunate as not to break any of the instruments in the descent. We found at the village nothing but a cart to carry us to the nearest station of the Strasburg railroad, which is 18 kilometres (11·18 miles) distant. The journey was a severe one over the cross-roads; the horse fell. Two of the pieces of apparatus which we were the most desirous of bringing back to Paris unhurt were broken, or rendered valueless; the globe of air, and the instrument which indicated the minimum barometric pressure. Happily the minimum thermometer of M. Walferdin was brought back with its seal unhurt, to the College of France.

"The seal was removed by MM. Regnault and Walferdin, and the minimum temperature, determined by direct experiments, was found —39·67, consequently differing very little from the lowest temperature which we ourselves had observed on the thermometer attached to the barometer.

"At the request of M. Regnault, MM. Person at Besançon; de Breauté

at Dieppe; Bertin at Strasburg; Hœghens at Versailles; Monod at Orleans; Renou at Vendôme; Malaguti at Rennes; Girardin and Bouton at Rouen; and Isidore Pierre at Caen, made, during the 26th and 27th July, barometric and thermometric observations every quarter of an hour."

For the Journal of the Franklin Institute.

Steam on the Upper Danube.

In some high pressure steamers, recently fitted out at Munich, by Mr. Joseph Hall, for boats navigating the Upper Danube, there is an arrangement which may be considered an improvement, and which might be made available on our western waters. Attached to the cylinder is one valve for the admission of steam, and two for its escape; the former is worked in the usual way, but the latter are made to work as follows: the exhaust valve communicating with the atmosphere, opens when the piston is $1\frac{3}{4}$ inches from the end of the cylinder, and continues open until the piston has completed its full stroke, and has come back $1\frac{3}{4}$ inches, when the first exhaust valve is closed, and the second, communicating with a condenser, is opened, and the steam remaining in the cylinder is condensed in the usual way. B.

Translated for the Journal of the Franklin Institute.

Experiments on the Thermo-Electric Power of Crystallized Bismuth and Antimony. Extract from a note by M. Svanberg, *communicated by* M. Regnault.

For some time past the observation of facts which it is useless to mention here, had led me to think that the thermo-electric force of the metals might probably depend on some variability in their conducting power for electricity. I was, moreover, led to believe that this conducting power ought to be variable in different directions in crystallized bismuth and antimony, since their crystalline form, according to the recent examinations of MM. Faraday and G. Rose, does not belong to the regular system. I was hence led to examine whether the thermo-electric power of these two metals would not also be variable with the direction. This supposition has been completely verified by the experiments which I am about to describe.

In large masses of bismuth or antimony the crystalline texture is never the same throughout, but it is not difficult to find homogeneous parts in them. Then with a saw we may form little bars whose length shall be differently inclined to their planes of crystallization.

Among the planes of cleavage of these two metals in the crystalline state, there is one, noticed first by M. Faraday, which differs from the others by greater brilliancy. This plane is perpendicular to the principal axis of crystallization. Among the other planes of cleavage there is one whose brilliancy is not much inferior to that of the preceding. I shall call (A) the bar whose length coincides with the intersection of these

two planes; by (B) I shall designate the bar whose length is perpendicular to the most brilliant cleavage-plane.

Antimony and Bismuth have this common property—the bars (A) are more positive, and those (B) more negative, in the thermo-electric series, than any other bar which can be formed from the same metal. The thermo-electric force between the Antimony (A) and (B), or between the Bismuth (A) and (B), is quite considerable. If a bar is taken intermediate between (A) and (B), that is to say, so that the direction of the length is differently inclined to the plane of cleavage, or if it has not a regular crystalline texture, it is negative with (A) and positive with (B). It will be seen that the direction of the length of the bars (B) agrees with the magne-crystalline axis of M. Faraday, as has been tried and confirmed for every bar employed. This axis took the axial position in Bismuth, and the equatorial for Antimony, which accords with the observations of M. Plücker.

This variability of the thermo-electric force of Bismuth and Antimony appears to give the key for the explanation of the currents observed by MM. Sturgeon and Matteucci, in circuits formed with only one of these metals. Heretofore they have not been explicable. As to the direction of the thermo-electric currents between hot bismuth and cold bismuth, or hot antimony and cold antimony, different experimenters have obtained different results. Vorselmann de Heer, who is the last who has attended to this subject, found that the current went sometimes from the cold metal to the hot, sometimes from the hot to the cold. He believed, from his observations, that the direction of the current depended on the greater or less difference between the temperatures of the bars. He says that he found these reversals particularly with antimony.

In order that such experiments shall have any value it is absolutely necessary that the bars operated on shall hold the same place in the thermo-electric series. Thus, for example, (A) must be compared with (A) and (B) with (B), but not (A) with (B). It ought, therefore, to have been first ascertained whether the two bars are absolutely homogeneous. It is very remarkable that (A) with (A) does not behave in the same way as (B) with (B).

My mode of experimenting was as follows: The two bars were fixed in copper handles, which by wires also of copper, were put into communication with a very sensitive galvanometer. From the points of contact with the copper, the bars were immersed in snow nearly to their free extremities; in this way no current could be excited by bringing the extremities in contact, and giving them any elevated temperature. This is the method of ascertaining satisfactorily that the bars are thermo-electrically homogeneous. But if, before putting them in contact, the extremity of one of the bars be slightly either heated or cooled, a current is established, whose direction the galvanometer indicates. If the two bars are of Bismuth (A) or Antimony (A), the current passes from the cold metal to the warm; if the bars (B) are operated on, the direction is opposite: that is, the current goes from the warm to the cold metal. This difference between (A) and (B) appears to me to be very remarkable, but I have verified it by multiplied experiments with different bars. I have never been able, in my mode of operating, to find any reversal of the

current when the difference between the temperatures of the two extremities was increased.

For slight differences of temperature, M. Vorselmann de Heer found, while experimenting on Antimony, the current going from the warm to the cold metal. The opposite direction, which I found for the Antimony (A), cannot be explained by any slight elevation of temperature which might have been communicated from the heated end to the point of junction with the copper; for it is easy to see that such a warming would have produced a precisely opposite effect. But it is very possible that M. Vorselmann de Heer may have experimented with bars thermo-electrically heterogeneous,—a very excusable inadvertence, since the connexion between the thermo-electric force and the direction of the current, relative to the plane of crystallization, was not then known.

For Bismuth (B) I found, as did the experimenters who have made the experiment before me, that the current passed from the warm metal to the cold. The opposite direction which I have observed for Bismuth (A) cannot either be explained by any slight elevation of temperature, which might have been communicated from the heated end to its point of junction with the copper, since an opposite effect would thus have been produced.—*Comptes Rendus de l'Acad. des Sci., Aug.* 19, 1850.

For the Journal of the Franklin Institute.

Screw Propellers.

Cannot the Institute throw some real practical light on this subject, viz: What is the best form of propeller? Should it have 6, 4, 3, or 2 blades? Which is the best angle? Should they be run at high or low speed? There are at least a dozen different patents, but none of them settle these points. What proportion should the propelling surface of the propeller bear to the immersed midship section of the vessel? At present, scarcely any two propellers are built alike; constant changes are made without *apparently* affecting the result. Are they all right, or all wrong? H.

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*English and American Steamship Building.—Ocean Navigation.—The Cunard and Collins Lines.**

Sir,—The publication of certain facts and drawings, in Nos. 1398 and 1408, relative to the rival steam-ships of the Cunard and Collins' Transatlantic Lines, induce me to address you as heretofore, under the same signature, which, though anonymous, shall, I trust, be supported by facts and figures sufficient to neutralize that disadvantage.

And I may state my reasons for this course. I do not wish to make your pages a vehicle for personal renown or professional advancement. I shall rigidly adhere to the truth, to the best of my belief, and utterly repudiate any personal allusions or antipathies. I should prefer to remain unknown; but I authorize you to give up my name to any one who, in your judgment, may require it for proper purposes.

* From the London Mechanics' Magazine, for September, 1850.

The subject of my remarks, and to which I earnestly desire to draw the attention of your readers, of the public, and particularly of English engineers, is the merits and demerits of the two systems of engineering adopted in the vessels of the Cunard line, which have been built and manufactured in this country; and in those of Collins' line, the production of our brethren in the United States. Both are excellent in their way, and each, in the absence of the other, would have been—indeed has been—considered perfection; but competition, and a very proper and laudable rivalry, has shown which of them it is best and most desirable to adopt in extending Atlantic steam navigation.

They have shown this to a certain extent, but no more. Neither of these lines of steamers (as it respects their machinery) have developed the highest state of engineering knowledge now and for some time past existing in this country. Humiliating as it may be to British engineers to acknowledge that they are beaten, although by their next of kin, it is tolerably certain that we shall have to make that admission; and your intelligent correspondent in No. 1398, prophesies this: to the best of my belief this will be so, has been so, and it is capable of very easy proof why it should be so.

But, that it could not have been otherwise, I utterly deny. I assert, that means are known to us by which both these systems (and they differ but in small degree) may be immeasurably excelled, at a much cheaper outlay, diminished cost for repairs, both in engines and ships, and a far more efficient result in all respects; and that this is not only practicable, but has really become an acknowledged fact, it shall be my object to establish.

Steam engines are of various constructions and mechanical arrangements;—in *principle*, they are as left to us by the immortal Watt. Modern necessities and ingenuity have introduced many deviations from his plans, and, as might be expected from extended practice and experience, with good result. Mr. Watt left us the "beam" or "side-lever" engine—excellent in its way, and suitable to his time (it has many votaries even now); others have introduced the "direct engine;" others, tubular boilers in place of *flue* boilers; others, feathering or eccentric paddle wheels, in lieu of the common radial wheel.

Cunard's vessels possess none of these improvements;—they have beam engines, flue boilers, and radial paddle wheels.

Collins' vessels have beam engines and radial paddle wheels; but the boilers are partly tubular, and *alone are the cause of their superiority over their competitors*. This has been so ably shown by your correspondent already quoted, in No. 1398, page 402, that I do not think it either necessary or just to occupy your space with further proof than to observe, that the great evaporative power of the boilers, and the extended grate surface, (a capacity to consume fuel with economy,) must be conclusive to the minds of all professional men, and that all other things being the same, we must succumb. We must "go-ahead" again by merely availing ourselves of the means we possess, and we assuredly shall be triumphant in a superlative degree.

This is matter of grave import for the consideration of those whose pecuniary interests are connected with the Cunard line of steamers; it is

still more of importance to another great and flourishing Company, of whom I shall speak hereafter, but whose infatuation and error is so utterly unaccountable, when we reflect that they ought to be—must be—fully aware of the great advantages they might have secured by a more able and discriminating course, which, if taken, would have been the means of placing them at the head of the steam navigation of the world. It will be their ill-fortune to see the great mistake they have made in the spring of 1850.

It must be evident to all men that small space occupied by steam machinery on board ship, and its minimum weight, compatible with strength and efficiency, must be that which is to be desired. All modern improvement has tended to this end; indeed, diminished weight of machinery is really *power*, for thereby you decrease the *immersion* of your ship, lessen her resistance, and increase her velocity, with a greater capability to carry her cargo and make a voyage remunerative, without additional outlay in fuel.

To do this to the greatest extent, there can be no doubt that we must adopt *oscillating or vibrating steam engines*, *tubular* or other improved boilers, and eccentric paddle wheels.

I have already remarked, that Cunard's vessels are fitted with the ordinary main lever engines, common flue boilers, and radial paddle wheels; the workmanship of the whole is excellent—in fact, it is a splendid piece of mechanism, and, of its kind, perfect. It has also been noticed, that Collins' vessels differ only in the construction of the boilers, which are partly tubular; and this, though but a small instalment of our knowledge, is still sufficient to establish a superiority, and therefore powerfully supports the position I have taken, and shall now proceed to make evident and patent to your readers.

The subject may be divided into the three portions already stated; namely, engines, boilers, and paddle wheels, and these I will take *seriatim*.

1. *Beam engines* are the most ponderous of all constructions now extant. I have before me a list of about 150 pairs of these machines, which, with common flue boilers and water, radial paddle wheels, and coal boxes, average about 23 cwts. per nominal horse power. The weights may be taken as follows, in decimal parts of a ton, and may be useful to many of your readers:

Engines alone,	= ·515	
Paddle Wheels,	·092	
Boiler and Apparatus,	·310	
Water in ditto,	·207	
Coal Bunkers,	·031	= 1·155,

or just 23 cwts. per nominal horse power. I believe this to be an average weight of beam engines, &c., as detailed; but, if report be true, the machinery of the Cunard steamers weighs even still more; it is said to be 1000 tons! which, for 800 horses power, is just 25 cwts. per nominal horse!

The superiority of Collins' vessels does not arise from *lighter* machinery, but from the greatly enlarged evaporative power of the boilers, without increase either in weight or space.

Beam engines are very expensive to manufacture. Oscillating engines,

at £40 per horse, (boilers and paddle wheels being the same,) is a more lucrative order than beam engines at £50 per horse, which will appear evident when we compare the quantity of *material* in the two kinds of engines;—they are more expensive in repairs, use more oil and tallow from the number of the parts, are subject to transverse strains, requiring an enormously strong and heavy bed-plate to counteract the pressure upon the main gudgeon, which has to resist *double* the force of the steam upon the piston.

It is also dangerous to work beam engines under heavy pressures of steam, unless the motive parts are made more than usually heavy and strong—generally 2½ times the nominal power is the usual practice. I know one or two instances where three times has been obtained, but accidents have resulted, to which they will always be liable; but make the connexions as strong and heavy as you please, these engines can never contend in this respect with the direct or oscillating engine.

The space occupied in the ship is also of paramount importance. Beam engines of 800 horses power will require not less than 35 to 36 feet in the most important part of the vessel. Oscillating engines of the same *nominal* horses power will have ample room in 14 or 15 feet, and they require less than one-half the timber foundation or "sleepers" to erect them upon.

The oscillating engine is self-contained; all its strains are direct—not doubled (as in the main gudgeons of beam engines); a great number of parts are banished, and simplicity in its integrity duly obtained: the centre of gravity of the whole is lower, and therefore tending to increase the stability of the ship; the wear and tear is less, and, when requiring repair, the cost is small from the few working parts. It may be made to bear almost any pressure by a slight increase in the crank shafts and piston rods. It goes at once to its work, which it does with vigour and certitude—indicator diagrams fully proving a proper effect for every atom of steam that is used.

And, lastly, the *weight* of the oscillating engine is just *one-half* that of the beam engine. A *pair* of oscillating engines, properly constructed, (for we have quacks in engineering as well as in medicine,) will weigh no more than *one* beam engine.

Taking an average of upwards of 3000 horses power which I have designed, the engines alone weigh just ·253 of a ton per *nominal* horse, or say 5 cwt. only.

Here, then, is a great secret, not so fully known as it should be; and I shall be amply rewarded if I succeed in convincing those of its truth who are so deeply and pecuniarily interested in this question.

It may be as well to insert here the weight of oscillating engines, tubular boilers, and mechanical wheels, which are as follows:—

Oscillating engines, ...	=·253
Patent Paddle Wheels, ...	·110
Tubular Boilers, having 16 square feet of absorbent surface per horse power and apparatus, . .	·215
Water in the Boilers, ...	·100
Coal Boxes, ...	·030
	·708

or just 14 cwt. per nominal horse! and this is not supposition, but what the writer has done with 3000 horses power, and what has been done by Penn for several years past in some of the finest of our men-of-war. The *Retribution* may be quoted, as one instance of the advantages to be obtained.

II. *Tubular boilers* have suffered much in reputation by being made too contracted in the water-ways, the tubes too close together, and the plates not sufficiently strong to resist the increased pressure used in them. They save both in weight and space, and are now designed quite free from the general objections made to them; they are not more expensive in fuel when a due proportion exists between the absorbent surface and the surface of the grates; and I know no reason why they should not be as durable as the ordinary flue boiler; they perhaps require more attention in blowing off, and keeping free from salt and earthy incrustation—that is all.

But the great saving is in the oscillating engine. If tubular boilers are objected to, we can have recourse to double tier flue boilers, which may be made with very slightly-increased weight and dimensions. The following Table will show the great improvements of late years in this branch of marine engineering:—

Years made in.	Per Nominal Horse.	Contents of Boiler in Cub. Feet.	Contents of Steam Chests.	Total Contents.	Area of the Base of Boiler.
1818 to 1840	Ordinary single flue boiler, an average of 107 boilers, . . .	20·75	1·75	22·50	2·750
1840 to 1850	Double tier flue boilers, an average of 20 boilers, . . .	14·60	1·90	16·50	1·290
1840 to 1850	Tubular boilers as hitherto made, . . .	9·25	2·00	11·25	1·083

Therefore, making an allowance for the proper enlargement of tubular boilers for the purposes of ocean navigation, there will not be found any important preference over the double tier flue boiler.

III. *Eccentric or feathering paddle wheels* possess very important qualities; and although I adhere rigidly to the general opinions many years since expressed in print upon these wheels, as *then* constructed, they are now so much improved in manufacture and design as to have become *commercially* useful. They are nearly double the weight of common radial wheels, quite double the cost, and, so far as my experience goes, still give very great trouble and labor to repair. But for ships of variable draught, accustomed to contend with heavy seas, and also as conducive to the comfort of the passengers and crew, they are invaluable, and far beyond their extra cost; therefore I recommend their use for Atlantic navigation.

In a former part of this paper I referred to the Royal Mail Company (West India) who have lately entered into contracts to extend their fleet by the addition of five superb ships of upwards of 3000 tons displacement, having beams of 39 feet, and 270 feet long, drawing 19·6 when fully laden.

I have already expressed my deep regret that this Company should

have contracted (with one exception) for the obsolete beam engine—flue boilers—and feathering or eccentric wheels. This they will assuredly regret; but having, I trust, fully shown the advantages to be derived from another course, I will devote the remainder of this paper to show what the Company will attain, and what they might have possessed with a less outlay—how they might have secured the greatest perfection, and how they have left open an opportunity for a vigorous and successful opposition to their earnest and sincere desires to uphold the permanency of their enterprize.

They have contracted for engines of 750 nominal horses power; now, as I have already stated that beam engines at £50 per horse is not so lucrative an order as oscillating engines at £40 per horse, hence they might have saved,

750 horses, at £50 per horse, ...	£37,500
750 " £40 "	£30,000

or £7,500 upon each pair of engines, or in the five ships no less a sum than £37,500, or just the cost of one pair of beam engines!

I need not say that the interest upon this amount is of some importance; or state the value of this sum as the nucleus of an insurance fund, and which this Company have hitherto found the use of in a more than usual degree. But the most important consideration will be the increased velocities of these ships, had they been fitted with machinery of the most improved and efficient kind.

I have already noted that their new ships are to have beams of 39 feet, and when laden and fully equipped for sea on starting from Southampton, are expected to draw 19 feet 6 inches of water.

The area of the immersed midship section will therefore be about 670 square feet.

We will also allow that the *indicator* power will be $2\frac{1}{2}$ times the *nominal* power, a very full proportion for beam engines to work safely under (unless they are made more than usually strong in the motive parts, as before explained.) We therefore have $750 \times 2{\cdot}5 = 1875$ horses power.

It is well known by engineers that the power required to propel ships is as the *cubes of the velocities*, and from an extended experience, I assert that the mechanical result may be represented by the factor 800, and it will be perfectly correct to take the area of the midship section (in each case) as the exponent of the resistance of the ship. Therefore the velocity will be

$$\frac{\sqrt[3]{1875 \times 800}}{670} = 13{\cdot}08 \text{ miles per hour.}$$

This is, with beam engines of 23 cwt. per nominal horse power, or a total weight of 862·5 tons complete.

I have already shown that oscillating engines may be made to weigh but 14 cwt. per horse, and to exert three times the nominal power, without the slightest increase in the parts, and when so strengthened (an inexpensive process) may be extended to $3\frac{1}{2}$ times the nominal power. Therefore 750×14 cwt. $= 525$ tons, or a saving upon the beam engine of 337·5 tons dead weight!!

The power of the oscillating engine will be $750 \times 3 = 2250$ horses, and

snpposing the 337·5 tons on board in the shape of CARGO (paying a heavy freight), the velocity would be

$$\frac{\sqrt{2250 \times 800}}{670} = 13{\cdot}90 \text{ miles per hour,}$$

an increase of 0·82 mile per hour by the superior power of the oscillating engine alone.

But this comparison is faulty, because we have not accounted for the decreased weight of 337·5 tons.

From the magnitude of these ships, each inch of their immersion will be equal to *about* 20 tons. Therefore

$$\frac{337{\cdot}5}{20} = 16{\cdot}875 \text{ inches}$$

decrease in the draft, so that the area of the midship section will be reduced by the lighter but more efficient machinery, from 670 to 614 feet; and using the same formula we shall have

$$\frac{\sqrt{2250 \times 800}}{614} = 14{\cdot}31 \text{ miles per hour,}$$

or an excess over the beam engine of (14·31 —13·08)=1·23 miles per hour.

I take from an original prospectus of the Royal Mail Company the route out and home at 10,500 statute *miles*, and though perhaps not absolutely correct, it will answer my purpose for an illustration of the advantages to be derived from improved machinery.

The *beam* engine will produce a velocity of 13·08 miles per hour—the *oscillating* engine, 14·13 miles (all things being the same). Therefore, this service would be performed by the former in 33¼ days, and by the latter in 30¼ days; and this saving of three days would be accompanied by the *insurance* fund of 37,500*l.*!

On the other hand, presuming that a cargo of 337·5 tons were taken on board, the voyage could be completed in 31¼ days,—a saving of two days, and the freight of the 337 tons of merchandise, which I leave others to set a value upon.

Applying these views and arguments to the Cunard's line of steamers, it is certain that if an average passage is now 11 days, it would become one of 9½ or 10 days at the most.

I may, perhaps, not be fully understood by your general readers; but I recommend this paper to the careful consideration of the profession, and to that of the powerful companies interested in the matter here discussed. You, Sir, know I have no trade-interest in what I write—I am not "looking for a job"—but do not wish to see the day when our pre-eminence as engineers can be called into question.

It would be a curious *finale*, if our brethren in America (far-seeing as they are) were to adopt the improvements now suggested. I believe that will be the result; and if they do, our boasted performances, as they now exist in ocean steam navigation will be entirely eclipsed.

I am, sir, yours, &c.,

PRESSURE, NOT PUFF.

Translated for the Journal of the Franklin Institute.

On the Distillation of Mercury by Overheated Steam. *By* M. VIOLETTE.

The new process for the distillation of mercury consists in plunging the mass to be distilled into a current of steam overheated to the temperature of 350° to 400° Cent. (662° to 752° Fahr.) The vapor acts both as a calorific and a mechanical agent; it, in the first place, heats the metal, so as to excite distillation, and then drives before it, and draws over the mercurial vapors, whose renewal it also facilitates; it hastens the distillation, as a current of hot air facilitates the evaporation of water; the steam charged with mercurial vapors are condensed together in a common refrigerant; the metal separates and sinks to the bottom of the vessel, while the condensed water flows out at the top. It is a rather curious thing to observe the liquid stream which flows from the refrigerant; two currents or streams may be distinguished, the upper one water, and below it the mercury; it is a continual current of each substance. No concussions are produced, and the operation goes on as tranquilly and easily as in the case of the distillation of common water.

The apparatus which served me in all my experiments was composed, first, of a cylindrical cast iron retort, which receives the recipient which contains the mercury; second, of a wrought iron worm in the upper part of the furnace which heats it. The steam circulates in the worm, is there heated to the proper degree, enters the retort, traverses it from one extremity to the other, passing over the surface of the mercury, and escapes with the mercurial vapors, to condense with the water and the mercury in the refrigerant.

In a series of tables, the author gives the results which he obtained in a series of experiments on the distillation of mercury alone or amalgamated; he indicates the quantities of steam necessary, and exhibits the economical advantages, which he sums up as follows, viz:

1. *Facility of the Operation.*—The boiling and distillation of water are substituted for the difficult and dangerous boiling and distillation of mercury; no more trouble in the management of the fire, no more danger of breaking the apparatus, no more difficulty in getting out the metal, no more notable destruction of the retort; a constant and determined temperature, much lower than the red-heat usually employed.

2. *Economy of Labor.*—A single laborer may manage a distillatory apparatus charged with 1000 kilogrammes of amalgam—the new process permits the largest dimensions.

3. *Economy of Fuel.*—This is certain, and practice alone can determine the amount. There will be no useless excess of fuel expended, since the apparatus will not be heated beyond the temperature necessary for the distillation of the metal.

4. *Economy of Mercury.*—The distillation of 100 parts of the amalgam of silver determines a loss of 2 parts of mercury. There are annually produced and distilled 6,000,000 kilogrammes of the silver amalgam; this is then a loss of 120,000 kilogrammes of mercury, worth at least 1,000,000 francs, ($200,000,) which this new process permits us to avoid.

5. *Public Salubrity.*—In the new process there is no loss of mercury;

the mercurial vapors are extinguished in the steam, and are condensed with it; moreover, in the common mode, the mercurial vapor still fills the whole apparatus, when this is opened at the end of the operation, and spreads into the air, while, in this latter method, the steam sweeps out all the metallic vapor from the apparatus, and the opening of it is without danger. The guarantee is thus complete, and the employment of overheated steam appears to have solved the problem which has been long sought after, to preserve completely the workmen from the mortal attacks of the mercury in the numerous and important branches of industry in which the distillation of this metal is required.—*Comptes Rendus de l'Acad. des Sci.,. Oct.* 14, 1850.

For the Journal of the Franklin Institute.

On Vertical and Radial Paddle Wheels.

The last four numbers of the Journal have contained several articles from Mr. Isherwood, one of the Chief Engineers of the U. S. Navy, advocating strongly the great advantages which, he contends, vertical paddle wheels have over the ordinary radial paddle, and a reply to Mr. I.'s first article by "M." who takes the opposite side of the question, and the one most generally received in England, where the wheel of Morgan is best known and understood. Without entering into any discussion as to the merits of the two wheels, and willing to leave the matter in the hands of those whose interest it is to have the best—the commercial community—I propose to examine some of the calculations and assertions of Mr. I., and see if they are worth as much as he would wish them to pass current for, and in his last article insists we shall take them at.

Mr. I. compares two vessels of 600 and 900 tons, and, without knowing the pressure on the piston, *assumes* it to be the same in each, because the pressure in the boiler was the same, and from his own reasoning claims two per cent. advantage for the vertical paddle. To prove his authority for this assumption, he states that it is a well known fact, that with wide throttles the initial steam pressure in the cylinder is from $1\frac{1}{2}$ to $2\frac{1}{2}$ lbs. less than in the boiler. Now, grant all this, what means has he of *knowing* what it was in these two steamers? He *assumes* the mean, (2 lbs.) and yet where is his authority for so doing? In one steamer it might have been $1\frac{1}{2}$ and in the other $2\frac{1}{2}$ lbs. less than in the boiler, and the extreme difference may as well have existed in *these steamers* as in any others. Again, his 17 lbs. is composed of pressure and vacuum, the last of which he has also *assumed* to be the same. Now, it is well known to every practical engineer, that not only do steamers that are similar vary in their vacuum, but vessels of the same dimensions in every respect will often vary a pound: nay, more, when there are two engines in the same vessel, the vacuum is better in one engine than in the other, and they oftener differ than agree. In proof of this, I have the experience of many good engineers, besides my own observation on many steamers. But still further, in all cases that have fallen under my own observation, where a steamer has had two engines unconnected with each other, (except that both obtained their steam from the same boiler,) one of the engines, with-

out any visible cause, would make from a half to one revolution more than the other per minute, being a difference of from 2½ to 5 pr ct. If, then, these differences exist where every thing is alike, who shall *assume*, in the absence of an indicator, that two steamers, unlike in every other particular, shall have the same pressure on the piston. It will at once be seen, that unless all the assumptions of Mr. I. are strictly correct, the two per cent. which he claims may be dissipated at once, and the balance may be against him rather than in his favor.

But, supposing all Mr. I. states to be correct, and that he is fairly entitled to the two per cent. on 20 feet wheels, is it proper to make such a comparison, when he must know that most of our sea steamers have wheels of 30 feet, and our European steamers wheels of 36 feet, and that in both cases the average dip does not exceed one-sixth of the diameter? An engineer who writes in 1850, is supposed to be doing so for the benefit of the present and not the past age. As to his assertions, that the vertical paddle may be made much superior to the radial wheel, by *increasing its slip* from 19·3 to 25 per cent., I can only say that narrow wheels and increased slip have been often tried, and have not given the results expected; and the mercantile community, both in this country and in England, are still sufficiently stupid to be satisfied with the old wheel, with all its disadvantages. "M." in his reply to Mr. Isherwood, states that in a trial between two vessels exactly alike, except in wheel, the one with the vertical paddle had to make two more revolutions per minute to equal in speed the vessel with radial paddles, and of course the one making the greatest number of revolutions consumed the most fuel. I understand Mr. I. to admit the fact as to the number of revolutions, which he accounts for; but he objects to the remark, that the one making the greatest number of revolutions per minute consumed the most fuel, and states that "M." is the first discoverer of this fact, and he is willing to give him all the credit of it. Now, let us examine into this, and see which is correct. At page 185, September No. of the *Journal*, we are told by Mr. I. that the power required to work the engine, overcome load of air pump, &c., was equal to a pressure of 2 lbs. per square inch on the piston. Now, assume that both of these vessels had single cylinders of 70 inches diameter, 8 feet stroke, and that the one with radial paddles made 16, and the one with vertical paddles 18 revolutions per minute, the power lost in working the engine will be as follows:

Radiating Paddle, $\frac{3848 \times 2 \times 256}{33000} = 60$ horse power.

Vertical " $\frac{3848 \times 2 \times 288}{33000} = 67$ "

From this data, given us by Mr. I. himself, it is very evident that more power has been expended in one engine than in the other to overcome friction, &c., and an increased expenditure of power involves an increased consumption of fuel, and, on this account, the increased loss from radiation. Clearance at the ends of the cylinder, and at steam ports, caused by oftener filling the cylinder, is not taken into account, and would show a greater difference than I have given.

Mr. I. states that the experiments made at Maudslay & Fields, and

witnessed by Mr. Barlow, were made without any sagacity of method, and both the experiment in its conduct, and the conclusions drawn from it, are erroneous. To prove this, I hope he will give us something more than assertions; a course of practical experiments, witnessed by disinterested engineers, would be valuable, and an assertion has value if supported by fact, but is useless without it. FULTON.

To the Committee on Publications.

Explosion of the Steamboat "Anglo-Norman."

NEW ORLEANS, Dec. 17th, 1850.

GENTLEMEN: Again we have had an explosion of a steam boiler in this vicinity, resulting in a loss of valuable lives and property. I have endeavored to gain as much information as possible from eye-witnesses, and an inspection of the hull and ruins early the next day after the explosion.

As no part of the boiler remains, it prevents certain conclusions being formed of the cause.

The new steam tow-boat "Anglo-Norman," built entirely here, after having been proved by three trips to and from the gulf with tows; the owners and makers invited many of the influential gentlemen of the city on an excursion trip, which took place on the 13th; the boat was run some distance up the river, and on her return, when about eight miles above the city, at 3 P. M., her boiler exploded, killing and wounding many of the persons on board.

For a better understanding I will give some particulars of the boiler. It was of the "wagon form," thirty feet long, sixteen feet wide, and nine and a half high, and weighed about 28 tons; in the interior there were four plain arches, (without any "water bridges,") extending to the back end, and above these were eight return cylindrical flues, about 15 inches in diameter; the water legs or sides were about four inches in the clear; each arch contained a set of grate-bars, and the lower part of the arched flues had the usual brick work and apron; to those practically acquainted with condensing engine boilers, it will be readily understood that this was one of the poorest plans for an economy of any kind of fuel, and more particularly when it was of anthracite coal.

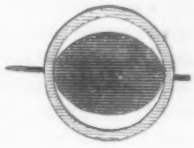
It was made by Armstrong & Co., regular boiler-makers, after a nearly similar one made in New York, and its workmanship appeared good; the only peculiarity I noticed from an outside view was that the iron was lighter than that used at the North for similar boilers; as far as the *shell* was concerned, and as it was not deteriorated by use, I considered it amply strong for a working pressure of fifty pounds to the square inch. I have understood that it was not intended to exceed the thirty-one inches of the mercury guage, but as the small tube of the guage took the steam from the end of the steam pipe some thirty-five feet from its attachment to the steam drum, it of course was not a correct indicator of the pressure in the boiler when the engine was in motion; not having seen the boiler after it was placed on board, I rely on others;—the safety valve was

above the steam drum—it also had the usual glass water gauge, blow-cocks, &c. On one side was a small engine to work extra pumps, and on the other side of the main boiler, was another engine to drive the blower, these were supplied with steam from a small high pressure boiler. The top of the boiler and its steam pipe was covered with hair felting to prevent the radiation of heat. By the testimony of the captain and others of the boat, given on oath at the inquest held on the body of Mr. Stillman, of the Novelty Works, New York, it was stated that the safety valve was adjusted to blow off at twenty-five inches of the mercury gauge before mentioned, and at twenty-six inches the steam would blow off freely, which was the case before the steamer left the wharf on this excursion trip. All that had noticed the water gauge and gauge cocks a short time prior to the explosion, concur in the opinion that there was plenty of water in the boiler; this I believe from the many *indications* on the wreck. The pressure of steam, as was shown by the gauge tube, and seen by many different observers a short time before the boiler gave way, range from twenty-two to twenty-six inches—weighing all the opinions on this point, I do not think that it exceeded the mean (24 inches). Now from the opinions of those on board, that the boiler did not make steam freely or enough, (and this is quite plausible,) the short time elapsing, from ten to fifteen minutes, at which the pressure was noticed, would not admit of a great increase of steam from the ordinary action of the fire, and the question arises, how did the explosion take place? As no part of the boiler remains, with the slight exception of some rivet heads, and a broken stay which had been inside the boiler, the answer can only be conjectural.

The power consisted of a horizontal condensing engine, with balance valves, and Sickel's cut-off; it is similar in plan, but far superior in workmanship, to one built at New York city and in use here. The cylinder is forward of the wheel shafts, and the boiler ahead of the cylinder, the furnace end being near the bow.

At the time of the explosion, the ash pan was moved a little ahead, and turned up on its edge; it is in good order; all of the grate bars and some of their bearers were thrown above fifteen feet from their original position on to the forecastle, they are uninjured; the same is the state of the foremast; it was wetted with dirty water, on each side, about twenty feet high; a little ahead of the boiler front remain, on each side, two posts or stancheons (unhurt), which support the carlins of the boiler-deck, some of the end pieces of boards still remain attached to them; these shew the marks of the dirty water; all the deck covering the boiler aft to the front of the small cabin, has been carried away. Bricks, and many pieces of light sheet iron work, and the broken steer-wheel are strewed on the main deck, some of the cast iron stands and pieces of sheet iron are carried aft nearly to the wheel shafts, and one check valve complete was thrown into the engineers' work-room, where also the second engineer was blown, and escaped with a slight scalding. The engine is scarely injured; the separation of the steam pipe from the side pipe, has been by the tearing and breaking of all the flanch bolts, leaving the vulcanised rubber joint remaining in good order; the end of the throttle

valve lever being fastened by the usual thumb screw, remains as it was at the time of the explosion; the steam passed this valve through a double crescent formed opening, measuring one-half inch at the greatest space; the diameter of the valve chamber being 15½ inches, gives such an area for the steam way as, for the size of the cylinder, 56 inches by 10 feet stroke, and a cut-off of about ½ stroke, and a working pressure of 24 lbs. to the inch, would confirm that "the boat was going along regularly."



All of the copper pipes, such as the feed, and blow pipes, &c., attached to the lower part of the boiler, pass up through holes in the main deck, and are torn off nearly where they were connected with the boiler; they consist of heavy copper, and the soft solder on the ends of some of them give no indications of over heating; these pipes being on both sides of the boiler, near the ends, remain battered, and each set drawn out on the deck, slightly inclined aft *towards* the starboard and larboard sides, in lines nearly at right angles with the centre of the hull. The top of the starboard wheel-house is shattered by some solid body coming in contact with it. On the arch of this wheel-house, outside of it, and the after part of the boiler deck, and the top of the cabin, (the most abaft) there are many pieces of sheathing paper, felting, and small pieces, &c., dust of anthracite coal, (I send you a piece of the largest, which is partly consumed, and a piece of the hair felting, the fibres being perfect, with the dirt attached,—it and the piece of coal were near each other); along with this coal dust there still remained much water where it could be retained, both on the top of the cabin as well as the boiler and main deck, and the dampness and dirt showed the inside edge well defined, as a small part of the deck was perfectly dry and clean.

The report was different in sound according to the position of those who heard it, thus: those nearest and above, described it as "dull;" further aft, "as a double report," (probably the boiler first, and the crashing of the wood work); and those at a distance off, "as a dull booming sound like a distant cannon;" whilst those on the main deck heard no report at all. One of the deck hands, sitting abaft the wheel shaft, in the passage formed by the wheel-house and engine timbers, heard nothing, but was knocked over by a rush of *cold air*, (something similar to the windage of a cannon ball). It is confirmed by different persons, that there was a discharge of water and steam from the safety valve pipe an instant before the explosion.

My opinion of the explosion is this: that one or both of the middle arches gave way, and the lower part of the boiler opened out sideways, driving every thing outside before it, and tearing off and stretching out the pipes on deck, as before mentioned, and discharging part of the water in its flight, and then the upper part (or probably all) rose up in the air slightly inclined to the starboard side, tearing off the steam pipe at its joint with the engine; and as the boat moved ahead, a part of it came in contact with the top of the wheel house, and here as the mass had nearly come to a state of rest, the remaining water, coal dust, &c., was discharged from it on the upper deck; the mass of iron then fell into

the river off the starboard quarter. One or more arches may have given way from the breaking or tearing away of the stays,* for it amounts to nothing that the pressure was less at that time than it had been before, for all conversant with machinery know that parts frequently give way when doing the least work. Another hypothesis is, that the intense local heat from anthracite coal just at that time may have caused the water to be driven out of the middle legs of the arches, and by opening the fire doors, pumping in water, or some other cause, the water passing back into the heated legs assumed the spheroidal state, or was otherwise instantly flashed into steam. That there was a sudden increase of pressure seems supported by the water and steam coming out of the safety valve pipe, by the valve being jerked up, and the water from the condensed steam formed in the pipe above the valve being ejected from it; or the safety valve may have been raised by the engineer, and if the first supposition is correct, the commotion caused by it produced a shock and started the rivets and stays of the arches.

That there was no neglect in the management of the boiler, seems certain, for there were too many practical men about not to notice it if such was the case; all who knew the first engineer, Mr. Samuel Hill, speak in the highest terms of his professional ability, and give him the rare quality of being over cautious; he received the cause of his death at his post along side of the engine, which he only left from time to time to pass quickly to and from the fire-room. The engine was made at the Messrs. Leeds' foundry. No one can say how many lives were lost, as many had gone aboard without an invitation; five have died since the explosion. It is intended to recover the boiler if possible;—if it is found I will furnish you a drawing of it and any other particulars I may learn.

I have been rather prolix in this account, but I preferred to give all the light on the subject I possessed, as it is only by apparent trifles that we will arrive at the solution of preventing steam boiler explosions. I may not be out of place in making a suggestion, which I have thought of doing for a long time. I have heard much testimony given on oath respecting explosions, without at all bringing out facts in a scientific point of view which would be invaluable data. I would recommend that a code of questions, covering every supposed circumstance attending a boiler before and after its explosion, be drawn up by the General Government, printed, and furnished to the authorities of each city, or to gentlemen of known scientific and mechanical knowledge, with power to take testimony on oath, and that *the questions and their answers* be transmitted to one of the bureaus at Washington City; by this means much valuable information would be elicited for the benefit of all.

Respectfully yours,

A. C. Jones.

P. S. The steamer "Knoxville's" boilers exploded at the levee a few hours ago, 6½ P. M. You shall have the details in a few days.

A. C. J.

* The rivet heads, found on the deck, are square breaks, such as rivets present by the very common habit of hammering too long; one end of the stay rod is torn off, and in the flattened part of the other end remains part of a broken rivet.

For the Journal of the Franklin Institute.

What constitutes an Engineer?

Within the last twelve months there have been three explosions on the Delaware, one at Baltimore, one at or near New Brunswick, N. J., and one at New York, all of them being boats belonging to this city, or but very recently from it. In two cases the safety valve was tied down. In three the boilers were too weak for the pressure used, and in one a probable want of water was the cause. In the first the guilty reaped their reward by immediate death. In the second the engineers in charge were made to suffer from the ignorance or carelessness of others. The introduction of high pressure steam tugs on our waters has materially enhanced the dangers arising from the use of steam, particularly as these vessels, from the simplicity of their engines, are often entrusted to men who have no idea of the responsibility of their position, and are entirely ignorant of the first principles of steam. Much ignorance prevails in the community on this subject. If a man has a greasy jacket, and rails at anything like theoretical knowledge, he is immediately set down as a *sound practical man*. Now there are many grades of engineers, each competent in his grade, but out of it often at a loss. There are those who may be called constructing engineers, whose business it is to design and superintend the construction of engines; of this grade there are several varieties. One may be perfectly at home on marine engines and know but little of locomotives, and the reverse; but each will understand the general principles of the other, although deficient as to details. Then there are two classes of practical engineers; one of which is a mechanic and is engaged in building, while the other is employed in running the engine when finished. The first of these may be ignorant of the details of practical operation, and the last is too often ignorant of the first principles of mechanics, either practical or theoretical. This last class do the mischief. They are those who literally kill their thousands, not intentionally, but through ignorance. The history of steam navigation on the Western rivers is a history of wholesale murder and unintentional suicide. We say the general diffusion of knowledge prevents crime—a truth none deny—and we raise money for free schools that all may have the privilege of enjoying them, and at the same time employ engineers who know nothing of the principles of steam or practical mechanics. If they are prudent, things go on pretty well, but if rash, we soon have the records of a fatal accident; if the engineer is killed, that ends the matter; if not, he is ready to swear, if necessary, that the boiler had a *plenty* of *water* and very little steam, *rather below the average*, and a report is made out which states that no one is to blame. At the West they rather enjoy these things than otherwise, and one year as a fireman has in times past been a sufficient recommendation as an engineer. I must not be understood as saying that all of this class are such as I have just been describing, but that it is too often the case. I am acquainted with some who, by years of practice, have become well worthy of confidence; but these men are now the last to deny, and the first to appreciate the value of proper theoretical or mechanical knowledge. Taking things as they are, and knowing the

fact that, for a few dollars a month, some owners of steamers will employ the ignorant, should not some means be taken to protect the community from the cupidity and ignorance to which they are too often subjected? We have laws that compel all owners of steamers to have their boilers inspected every six months, while at the same time we allow them to have any person for an engineer. A proper inspection of those who have charge of steamers is necessary to the public good. FULTON.

On the Form of Shafts and Axles. By MR. THOMAS THORNEYCROFT.*

In order to arrive at proper proportions for any of those principal media of power, which are so fully employed in almost every branch of manufacturing science peculiar to this kingdom, two or three leading points obtain, as axioms on which to reason, in order to arrive at satisfactory results.

Taking, for instance, iron as the material in question, it is required to apply it in an entire new sphere of mechanical movement; the first leading point for examination is the law which limits the tensile and compressive powers of that material, and should the various forces which are about to be put into operation, be by any means calculable quantities, the tensile and compressive powers of the material being determined, there is before us an easy mode of arriving at satisfactory results.

It has, however, been found of equal importance thoroughly to investigate the cause of every failure in this material, and mark those parts where the greatest amount of weakness appeared, so that in re-construction the simple laws of strength, as determined by experiments, are applied in connexion with the results of practice, in producing principles of form and mechanical arrangement, better and safer than either of them alone would have done: yet, notwithstanding that by these means safer results have been obtained and brought into use, from the rapid advance of mechanical contrivance, the moving parts of machinery are being daily subjected to untried and incalculable forces; hence the necessity of uniting to former experiments and practice, experiments and contrivances as closely analagous to the peculiar circumstances which are found to operate so powerfully in deteriorating and destroying that most valuable material now under consideration.

It would be deeply interesting to trace the many changes which have taken place in the formation of the various structures, both of cast and wrought iron, which have been brought into use during the last fifty years; some of these remain to the present, monuments of the skill of their projectors, and at the same time proofs of the soundness of the principles on which they have been constructed: on others, causes have been in constant operation, gradually reducing the strength of the original mass until they have become unfitted for the purposes of their erection.

In not a few instances these causes of weakness have been detected, and proper remedies applied by better arrangement of materials; and, in some instances, by the adoption of entire new principles of construction.

* From the London Artizan, for November, 1850.

If our attention is directed to the bridge class of structures, we perceive that, previous to the introduction of railways, the more general form was the simple arch, which, whether constructed of cast or wrought iron, there is left indisputable proof that the arch, as a principle, cannot be excelled, either for stability or durability, and that, simply because there are in it fewer elements of self-destruction than in any other form or principle which has been applied for the like purpose. Hence it is not too much to presume, that just in proportion as we leave the principle of the arch, and approach that form which necessity, in many cases, has rendered imperative, we introduce elements which, if not carefully watched, must sooner or later prove fatal to the stability of the mass.

To determine what these elements of self-destruction are, and to what extent they are in operation, has lately occupied the highest mathematical and practical talent of this kingdom; and they have recorded as the result of their experiments and investigation, that to resist the effects of reiterated flexure, iron should scarcely be allowed to suffer a deflexion equal to one-third of its ultimate deflexion, for should the deflexion reach one-half of its ultimate deflexion, fracture will sooner or later take place. It is, therefore, reasonable to conclude that the greater the amount of rigidity it is practicable to introduce into structures of this nature, the fewer will be the self-destroying elements in operation, and, consequently, the greater their durability.

These deductions will receive very considerable support from the history of the various descriptions of shafting employed in the different manufactories of this country; previous to the introduction of the slide lathe, the shafting employed in the spinning manufactories was a constant source of vexation and expense; the want of that perfect parallelism which is now obtained exposed the shaft to vibration or bending at every revolution; the consequence was constant fractures. The same results have been observed and recorded in reference to the shafting in use in the iron works of this district; and if we pass to the main shafts of water wheels, or the intermediate shafts of marine engines, we see that what at one period of their history was considered good in principle, (viz.—parallel shafts,) have had to give place to others, more generally of increased diameter at the centre, or if parallel greatly in excess of former practice. Perhaps no better case could be selected than that of the intermediate shaft of a marine engine to illustrate the subject now before the institution, for there might be traced an almost perfect agreement in all the forces which act upon that shaft, and on the axles of either engines or carriages on a railway.

The author of this paper being a manufacturer of railway axles, has had his attention drawn to the subject of the form of axles for some considerable time; and from his knowledge of the properties of iron, and his observations of the fractures of shafts and axles, has concluded that various forms of shafts and axles possess elements of self-destruction—that the fractures which take place are generally confined to given parts, and that those parts where fracture takes place exhibit errors of mechanical construction, or errors of mechanical arrangement, when in motion.

A very extensive course of experiments has been gone through by the author, approximating as closely as possible to the forces on axles when

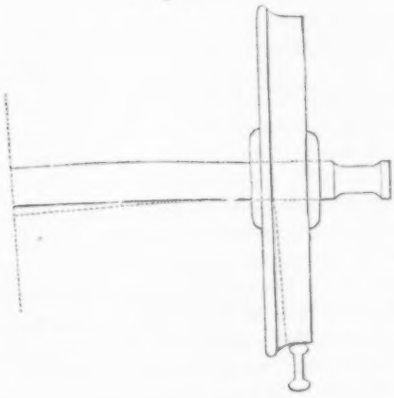
in use; and these have satisfied his mind, that just in proportion as there are departures from certain fixed principles of construction in either shafts or axles, in the same proportion will be their liability to fracture.

Before passing to an examination of the experiments, it may assist to a more correct elucidation of the subject if the railway axle is viewed as having certain relations to a girder in principle. Girders generally have their two ends resting on two points of support, and the load is either located at fixed distances from the props, or dispersed over the whole surface; just so with the axle; it has its points of support and its loaded parts, but it is not clearly evident which are the loaded parts and which the props. It has been stated that the wheels may be considered the props, and the journals the loaded parts; but it is thought that with equal propriety the journals may be considered the props, and the wheels the loaded parts: if this latter opinion is at all admissible, we then have the load brought much nearer the centre of the axle than in the case where the journals are considered the loaded parts; and, besides, it brings more immediately before us the influence which the inclined bearing surface of the wheels will necessarily have in increasing the power of any lateral or vertical blow, which the axle will receive through the wheels. It is found that the inclined surface of the wheel tire ranges from 1 in 12 to 1 in 20, and, as a matter of course, the direct tendency of the wheels under a load is to descend that incline, so that every vertical blow which the wheels may receive is compounded of two forces, viz.:—the one to crush the wheels in the direction of their vertical plane, and the other to move the lower parts of the wheels together; it will be seen that these two forces have a direct tendency to bend the axle somewhere between the wheels; should that yielding or bending extend no farther than one half the elastic limit, if long continued, fracture will ultimately take place; but should the elastic limit be exceeded, the axle takes a permanent bend, the wheels are then diverted from their vertical plane, and, as a matter of course, leave the rails. To demonstrate this is the object of the first experiment. An axle reduced in the middle to $1\frac{3}{4}$ inch dia. was placed upon two props 4 feet 9 inches apart, and loaded in the middle, the utmost of its deflexion without a permanent set was ·232 inches, the load carried 7 tons. An axle reduced to 4 inches in the middle, and then placed upon the props 4 feet 9 inches apart, its utmost deflexion without a permanent set was ·281 inches, the load carried 9 tons. Another axle, but parallel, $4\frac{5}{16}$ inches diameter, was placed upon the props 4 feet 9 inches apart, its utmost deflexion, without a permanent set was ·343 inches, the load carried 14 tons. Hence, by reducing an axle of $4\frac{5}{16}$ ins. diameter in the middle to $3\frac{3}{4}$ inches, its limit of elasticity is reduced from ·343 inches to ·232 inches, and the load, to produce that elasticity, from 14 to 7 tons. Fig. 1 shows the position of the wheels to the rails when the bending of the axle has exceeded its elastic limit.

The object of the second experiment was to ascertain what influence the reduction of an axle in the middle would have on its strength to resist sudden impact, compared to an unreduced one; this axle was made as represented by fig. 2, which shows the end A parallel to the centre $4\frac{1}{2}$ inches diameter, and the end B is drawn down from the back of the wheel towards the centre, where it is 4 inches diameter. The end A was then

subjected to impact—the relative position of prop and ram was the back of the wheel and the neck of the journal, this end received 46 blows of the ram, and bent to an angle of 18°. The end B was then subjected to impact—the prop and ram in the same relative position, when it bent back to an angle of 22° with only 16 blows of the ram, (as shown by the dotted lines in fig. 2.) The object of the third experiment was to ascertain what

Fig. 1.



Figs. 2 and 3.

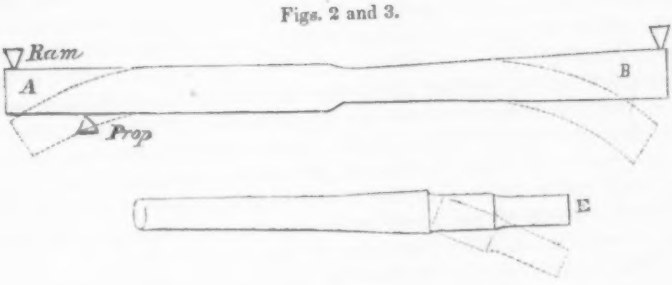
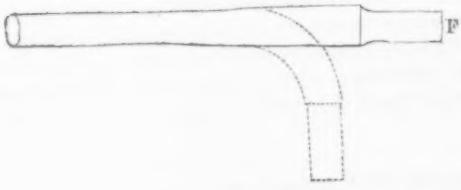


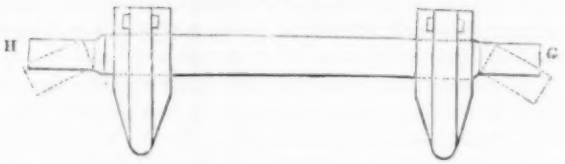
Fig. 4.



influence a shoulder behind the wheel would have on the strength of the axle at that part, compared to one without a shoulder. Fig. 3 and 4 were one axle cut in two, the end E was turned from the neck of the journal, leaving a shoulder $\frac{1}{8}$th inch deep as a stop to the wheel; the end F was turned from the neck of the journal to the same diameter, but no shoulder

left. The end E was subjected to hydraulic pressure, the load being in a direct line with the shoulder, when it broke in two with a load of 60 tons. The end F was subjected in the same way to hydraulic pressure, when it bent into the form shown by the dotted lines, with 84 tons. The object of the fourth experiment was to ascertain what influence the position of the wheel, in relation to the neck of the journal, would have on the strength of the journal under impact. Fig. 5 was a piece of an axle with

Fig. 5.



a journal taken down at each end; the end G was keyed into a cast iron frame, the face of the frame in a line with the neck of the journal, the journal was then subjected to the impact of a ram falling 10 feet, when it broke off at the 7th blow. The end H was keyed into the cast iron frame in the same way, but with the neck of the journal projecting 1½ inches from the face of the frame, the journal was then subjected to the impact of the same ram falling 10 feet, when it broke at the 24th blow.

From these experiments, and from the acknowledged deteriorating influence of vibration or bending on iron, especially when continued any great length of time, it is the author's opinion that neither shafts nor railway axles ought to be reduced in the middle, but rather, if there is to be a departure from the parallel form, they should be made thickest in the middle, and thus effectually prevent any vibration or bending whatever: for it is the introduction of this principle into almost every description of beam and girder, also into the connecting rods of every description of steam engine, and into a large quantity of the shafting now in use, that has rendered the whole of these articles so superior in point of durability to what they were when other principles of form were in use.

Mr. Thorneycroft gave a further illustration of the paper by reference to several specimens of axles which were exhibited to the meeting. Having obtained an axle which had a shoulder at both ends, he turned the shoulder off one end but left it on the other, and he found that in the instance where the shoulder was turned off, it required a pressure of 120 tons to break it, and 1½ inch deflexion; while the other end, where the shoulder was not turned off, broke with a pressure of 105 tons and ⅞ of an inch deflexion.—*Proc. Lond. Inst. Mech. Eng.*

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*Magnetic and Diamagnetic Condition of Gases.**

The Bakerian Lecture was delivered yesterday (Nov. 28, 1850) by Prof. Faraday to a crowded audience. At this late period of the month we can only glance at the highly interesting investigations laid before the Royal Society, reserving a fuller notice for our next number.

* From the London, Edinburgh, and Dublin Philosophical Magazine, December, 1850.

One of the conclusions arrived at by the author was, that the motions of magnetic and diamagnetic bodies in each other do not appear to resemble those of attraction or repulsion of the ordinary kind, but to be of a differential action, dependent perhaps upon the manner in which the lines of magnetic force were affected in passing from one to the other during their course from pole to pole, the differential action being in ordinary cases between the body experimented with and the medium surrounding it and the poles. A method of showing this action with the gases is described, in which delicate soap-bubbles are made to contain a given gas, and then, when held in the magnetic field, approach, or are driven further off, according as they contain gases, magnetic or diamagnetic, in relation to air. Oxygen passes inwards or tends towards the magnetic axis, confirming the results formerly described by the author.

Perceiving that if two like bubbles were set on opposite sides of a magnetic core or keeper cut into the shape of an hour-glass, they would compensate each other, both for their own diamagnetic matter and for the air which they would displace; and that only the contents of the bulbs would be virtually in a differential relation to each other, the author passed from bubbles of soapy water to others of glass; and then constructed a differential torsion balance, to which these could be attached, of the following nature:—A horizontal lever was suspended by cocoon silk, and at right angles to the end of one arm was attached a horizontal cross-bar, on which, at about 1½ inches apart, and equidistant from the horizontal lever, were suspended the glass bubbles; and then the whole being adjusted so that one bubble should be on one side of the iron core and the other on the other side, any difference in their tendency to set inwards or outwards from the axial line causes them to take up their places of rest at different distances from the magnetic axis; and the power necessary to bring them to an equidistant position becomes a measure of their relative magnetic or diamagnetic force.

In the first place different gases were tried against each other, and when oxygen was one of them it went inwards, driving every other outwards. The other gases, when compared together, gave nearly equal results, and require a more delicate and finished balance to measure and determine the amount of their respective forces.

The author now conceived that he had attained to the long-sought power of examining gaseous bodies in relation to the effects of heat and the effects of expansion separately; and proceeded to an investigation of the latter point. For this purpose he prepared glass bubbles containing a full atmosphere, or half an atmosphere, or any other proportion of a given gas; having thus the power of diluting it without the addition of any other body. The effect was most striking. When nitrogen and oxygen bubbles were put into the balance, each at one atmosphere, the oxygen drove the nitrogen out powerfully. When the oxygen bubble was replaced by other bubbles containing oxygen, the tendency inwards of the oxygen was less powerful; and when what may be called an oxygen vacuum (being a bulb filled with oxygen, exhausted, and then hermetically sealed) was put up, it simply balanced the nitrogen bubble. Oxygen at half an atmosphere was less magnetic than that at one atmosphere, but more magnetic than other oxygen at one-third of an atmos-

phere; and that at one-third surpassed the vacuum. In fact, the bubble with its contents was more magnetic in proportion to the oxygen it contained. On the other hand, nitrogen showed no difference of this kind; whether a bubble contained that gas more or less condensed, its power was the same. Other gases (excepting olefiant and cyanogen) seemed in this first rough apparatus to be in the same condition.

Hence the author decides upon the place for zero, and concludes that simple space presents that case. When matter is added to space it carries its own property with it there, adding either magnetic or diamagnetic force to the space so occupied in proportion to the quantity of matter employed; and now thinking that the point of zero is well determined, he concludes to use the word magnetic as a general term, and distiguish the two classes of magnetic bodies into paramagnetic and diamagnetic substances.

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*The Flax Manufacture.—Steeping Superseded, and the Fibre adapted to Cotton Spinning Machinery.**

One of the greatest obstacles which has hitherto stood in the way of an extended cultivation of flax, viz., that of the trouble, delay, and expense attendant upon its steeping, in order to prepare it for the market, has now been removed, by an invention which entirely dispenses with that process, and enables the grower at the smallest possible cost to send his fibre into the market. By this process, of which Mr. Donlan is the inventor, the results are obtained by a combination of chemical and mechanical means, and as it avoids all the expenses connected with steeping, the fibre may be prepared at a cost considerably below that incurred in the present process, and may be made, we are assured, applicable either for fabrics of the coarseness of nail bags or canvas, or of the fineness of the most beautiful Brussels lace. But not only is the expense considerably less, but the time consumed in the preparation of the fibre, which, by the old process, ranges from ten days to three weeks, does not exceed as many hours by the unsteeped mode. It also possesses a vast superiority on account of the extreme simplicity of the means adopted, which may be made intelligible to, and performed by, a mere child. But by far the most important and valuable part of this invention is, that it produces a fibre perfectly clean, and in its natural state, without any of the stains or impurities which necessarily attach themselves to the fibre during the process of steeping, and it also possesses the advantage of securing that regularity and uniformity of strength which to a greater or less extent is wanting in the steeped fibre. Application has been made for a charter of incorporation for a company which will be prepared to purchase the flax produced upon 100,000 acres in Ireland, at 12*l.* per acre, and to prepare it for the market in cases where the grower may not possess the necessary facilities for preparing it himself.

The uniformity of strength and freedom from stain or impurity which exists in the flax prepared by the unsteeped process, has, within the last four days, led to the practical demonstration of an invention, of the value

* From the London Mechanic's Magazine, for November, 1850.

and importance of which, to the agriculturists and manufacturers of this country, it is impossible to form any adequate idea, and which consists, among other things, of the adaptation of the flax fibre to cotton machinery. The patentee of this invention is M. Le Chevalier P. Claussen, member of the Brazilian Institute, well known as the inventor of the circular loom, and by his collections of objects of natural history and plants of South America in the British Museum, and in the Museum at Paris. We had placed in our hands a quantity of flax rovings and yarns spun upon cotton machinery by the inventor, and we have had an opportunity of personally inspecting at Manchester the whole process connected with the invention, and the result has fully convinced us of its practicability. The finest portion of the yarn spun, in our opinion, and we were confirmed in it by a gentleman of great experience and long connexion with the cotton trade, was equal in fineness to 120's cotton, the coarsest being equal to 50's. The application of such a test as that of 120's for the first time was certainly a most severe one; the result, however, was perfectly successful. A slight difficulty arose at first with the machinery, in consequence of the length of the fibre; this, however, was easily obviated by a slight alteration in the position of one of the rollers. As the fibre, however, may be prepared to any length, there will be no necessity in future for even this alteration, the existing cotton machinery being perfectly adapted for the purpose of spinning flax prepared according to the process patented by M. Claussen.

The patent granted to M. Claussen for England, is for the preparation of flax in a short staple, so as to produce a substitute for wool and cotton capable of being spun upon cotton machinery, and also for the mixture of the materials thus obtained, which can be carded together with silk, cotton, or wool, or separately, as cotton for spinning into yarns. The right is also secured for preparing long fibre as a substitute for silk, for bleaching in the preparation of materials for spinning and felting, and also in yarns and felts. The inventor does not, however, confine himself to flax for the purpose of producing a fibre adapted to his purpose, but states that he can obtain similar results from hemp, jute, Chinese grass, and, to use his own expression, from "an old tar rope, or a bamboo cane."

As the patents are not yet secured for several continental states, we are not at liberty to state the nature of the process, or the means adopted for the purpose of bringing the fibre into the required state. We may state, however, that from $1\frac{1}{4}$ cwt. of the flax fibre prepared and cleaned upon the unsteeped process, 1 cwt. of a substance, identical with clean cotton, can be produced at a cost for material of less than half a crown. The cost of manual or mechanical labor required in its preparation, including the expense of bleaching, an operation performed in a few seconds, does not amount to more than seven-sixteenths of a penny per pound.

The mixture of the two substances, viz., wool with flax reduced to a short staple, forms a fabric exceedingly durable, while its cost may be judged by the fact, that while wool costs 4*s*. 6*d*., the flax prepared and ready for spinning may be obtained for 6*d*. per pound, so that with flax

and wool spun together in equal quantities, the cost would be reduced by nearly one-half.

But although the inventor has obtained a patent for the preparation of a fibre as a substitute for cotton, he does not indulge the visionary and impracticable idea of being able to drive cotton out of the markets, his object being simply to provide a substitute for low cottons, in the manufacture of a variety of fabrics in which that valuable and over-wrought material now forms a part. In a branch of our trade, however, for the supply of which upwards of 770,000,000 lbs. of cotton were last year imported, it is not too much to suppose that there exists ample room for the consumption of very large supplies of home-grown flax, while the facilities which are now found to exist for carding and spinning together flax and wool, must also tend to open up new sources of demand among the manufacturers of Leeds and Bradford.—*Morning Chronicle, Nov.* 14.

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*On the Consumption of Smoke from Furnaces and Chimnies—Abatement of the Smoke Nuisance.**

The Town Council of Manchester are pushing to a practical test their powers (under a local act) of compelling the manufacturers to consume the smoke of their furnaces. A report of the Council's sub-committee on the subject contains this very encouraging summary of their successes:

"In conclusion, your sub-committee congratulate the committee upon the fact, that, in many instances, chimnies which were at one time the worst in the borough, and which almost incessantly emitted dense smoke, are now amongst the best; and upon the still more important and significant fact, that your sub-committee have obtained the favorable opinion of mill-owners generally as to the practicability of preventing smoke at what are termed heavy mills, and that such prevention can be secured without loss. In several instances, parties who had most strongly expressed an opposite opinion, have with evident pleasure assured your sub-committee that they no longer entertain any doubt as to the practicability of preventing smoke, but also that such a happy change may be attained, if not with considerable economy, at any rate without loss."

Councillor Howarth added these interesting details—

"He lately waited on Mr. Hugh Beaver, and ascertained that the quantity of coal formerly used per week in his manufactory was 78 tons, whilst by the consumption of smoke and the improvement consequent on the adoption of the system, a weekly saving is effected of 28 tons. 'I visited Messrs. George Clarke & Sons' manufactory,' continued Mr. Howarth, 'and they told me the saving they effected by consuming the smoke from their fires was upwards of 40 tons per week. They formerly used 140 tons per week, now they consume less than 100 tons. They have expended upwards of 1200*l.* on new boilers to their steam-engines, in order to abate the smoke nuisance; and they expect the outlay will be repaid by the saving of coal effected in a year and a half.' "

The local correspondent of a London journal observes—

"No one who has visited this town recently, and who recollects the dense

*From the London Mechanic's Magazine, for November, 1850.

clouds of smoke which overhung the borough, but must make a very pleasing comparison in favor of the present appearance and condition of our streets; and it is not less encouraging to find, from a statement made this morning by Mr. Councillor Howarth, that all this improvement has been effected not only without loss but to the positive advantage of the manufacturers. It is unquestionable that our manufacturers at the outset thought this legislative interference a great hardship; indeed, when summoned before magistrates, it has not been unusual to urge that the mitigation of this nuisance was a delusion, and that the consumption of smoke was utterly impossible."

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, December 19, 1850.

S. V. Merrick, President, in the chair.
Thomas Fletcher, Vice President.
Isaac B. Garrigues, Recording Secretary.
John F. Frazer, Treasurer.

The minutes of the last meeting were read and approved.

Letters were read from Messrs. Fox, Henderson & Co., London, and John M. Bernhisel, Esq., City of New York.

Donations were received from Lieut. W. Reid, London, through W. C. Redfield, Esq.; Messrs. Fox, Henderson & Co., London; Hon. Joseph R. Chandler, U. S. Congress; Messrs. Wm. E. Morris, E. D. Ingraham, and Frederick Fraley, Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statement of the receipts and payments for the month of November was read.

The Board of Managers and the Standing Committees reported their minutes.

The Committee on Exhibitions reported the following resolutions in relation to the subjects referred to them by the Institute at its last meeting:

Resolved, That this Committee recommend to the Institute to award to Messrs. Cornelius & Co., of Philadelphia, a Recall Gold Premium, for the Lamps and Gas Fixtures made and deposited by them at the late Exhibition.

Resolved, That by our printed circulars, and the same as published in the daily papers, we have advised all depositors that the Institute will not be responsible for any articles deposited at our Exhibition, therefore, with regret, we are compelled to deny the claim for $10, for the Tidy deposited by Mr. T. Bonney, and lost.

The same Committee also presented the following report:

That they have revised their report of the late Exhibition, and have awarded to

No. 2611. Composition Marble Mantels, Slabs, and Ornamental Work, made by Thos. W. Dufrene, of Philadelphia, *A Recall First Premium.*

No. 2603-4-5. Composition Statuary and Figures, made by Edward Dufrene, Philadelphia, *A Recall First Premium.*

A report from the Committee on the School of Design for Women was read.

On motion, a Recall Gold Premium was awarded to Messrs. Cornelius & Co.

Resignations of membership in the Institute (3) were read and accepted.

Candidates for membership in the Institute (7) were proposed, and those proposed at the last meeting (149) were elected members of the Institute.

On motion, it was

Resolved, That the first resolution of the Institute, for the establishment of the School of Design for Women, be altered by substituting the words 'Treasurer of the School Committee' in place of 'Treasurer of the Franklin Institute,' where it occurs in the 5th line of the printed copies of the resolutions.

Resolved, That the President be authorized to appoint ten ladies and ten gentlemen a Committee of Visiters to the School of Design for Women.

Resolved, That the Committee on Publications present a copy of the Journal of the Institute to the Territory of Utah, agreeably to the request of J. M. Bernhisel, Esq., read this evening.

Nominations were made of persons to be voted for at the Annual Election for Officers, Managers, and Auditors, to be held in January next.

On motion, it was

Resolved, That the Annual Election for Officers, Managers, and Auditors, for the ensuing year, be held on Thursday, January 16, 1851, between the hours of 3½ and 8 o'clock, and that seven members be appointed a Committee to receive the votes of the members and report the result.

The Committee were appointed.

Mr. William D. Parrish called the attention of the meeting to the explosion of a steam boiler which recently occurred in Broad street, above Vine, Philadelphia. The explosion took place upwards, carrying off the head of the boiler (which was of cylindrical form, about 4 feet in diameter, and placed in the upright position) entire—the line of fracture following exactly the angle of the flanch with scarcely any variation, blowing off the circular head of the boiler, and leaving the flanch attached to the case of the boiler. This head was carried to the height of several hundred feet into the air, and fell in Broad street, about 100 yards from the boiler. The roof of the building and the adjoining walls were scattered in all directions, but no one was injured, although several workmen were employed at the time very near the boiler, and there were a number of dwellings in the vicinity.

The bottom part of the boiler contained the fire-box, say 38 inches in diameter, which was surrounded by a water leg of about 4 or 5 inches, the fire-hole opening through the leg in the usual manner. On the crown of the fire-box four vertical smoke flues, of about 9 inches diameter, were riveted, passing up into a circular smoke-box corresponding in diameter with the fire-box, and leaving a water space around it of about 4½ inches. One side of this smoke-box was elongated and riveted to the shell of the boiler, thus forming a smoke-pipe passing through the water space, which conducted the hot air into a brick flue of about 4 inches surrounding the

boiler, and distributing the heat over its exterior surface from the point of entrance to the top of the boiler, covering part of the water surface and nearly the whole steam surface. From this brick flue an iron pipe conducted the heat to the smoke stack.

The head of the boiler was made of boiler iron, near $\frac{3}{8}$-in. thick, with a flanch turned to fit the inside of the casing, and riveted to it. The man-hole and safety valve were in this head, and it had been secured by 17 stay-bolts distributed over its surface, which passed down and were secured to the crown of the smoke-box.

The boiler had been in use about two years prior to the accident. Two gauge-cocks were placed about 8 or 10 inches above the crown of the smoke-box. The safety valve lever was found much bent, but the valve and valve seat were lost. From inquiry, however, as to the size of the valve, &c., and observation of the diameter of the pipe, it was believed that, with the weight at the end of the lever, it would require a pressure of 160 lbs. to the square inch to raise the valve. The engine was represented as being overtasked, requiring all the steam the boiler could make to do her work, and the explosion occurred during a temporary stoppage for the adjustment of some of the machinery, when the boiler was under her working pressure and generating steam rapidly.

There was no evidence of water having been low in the boiler at the time of the accident, but I was convinced that there had been much carelessness at times by the person having charge of the engine, as it was admitted that extra weights, such as pokers, had been hung upon the safety valve lever on former occasions, although it was stated not to have been done recently. On examination of the iron flanch of the head of the boiler, it was found to be very brittle, and there is little doubt that the angle of the iron was defective at the time the boiler was made, or had been rendered so by the unequal strains to which the head had been subjected, and it was evident by the examination of those stay-bolts which were found, that many of them had been useless for a long time, showing, as they did, very few recent fractures.

Dr. Turnbull presented to the meeting two beautiful specimens of Oxide of Zinc Paint, dry and in oil, one specimen manufactured by the New Jersey Company, from the zinc ore found in Sussex county, N. J.; the second made by Leclaire, of Paris. An oral communication was made by him on the subject of its being perfectly harmless, and not causing any of the attacks resulting from white lead on the human body, and other serious dangers to workmen making or using it, or to persons inhabiting newly painted rooms. It is a purer white, covers as well as the first quality white lead, and does not require a greater number of coats. He exhibited specimens of the paint on glass, and compared it with the finest white lead. The price, at present, is double that of lead, but, on account of its lightness, it will cover a much larger surface.

The New Jersey specimen was as white as the French, and sold at a less price, they having improved very much in its manufacture since last March, at which time he brought the subject before the Institute, the lot marked No. 3 being one obtained from them at that time.

The oxide of zinc paint will be found a most admirable article along

the sea coast, not being changed by the agents which destroy the white lead, for when acted upon by hydrochloric acid and hydrosulphuret of ammonia it was not altered in color, while the white lead becomes black or brown. It is not changed by sulphurous exhalations so common in cities; it preserves its whiteness in coffee houses, theatres, laboratories, stables, &c.; also in vessels, notwithstanding the gas arising from the hold. Mastics can be obtained with the oxide of zinc, either in oil or water, superior to those made of white lead, and it is now used in the large establishment of the Messrs. Merrick & Son, particularly for the seams in machinery.

This paint acquires a hardness which permits a very fine polish, being a most admirable covering for all kinds of metallic surfaces, and resisting the action of the air.

It is well adapted to artistic painting in oil, water, wax, or water colors, and permits the drawing of the finest lines.

Mode of Applying the Zinc Paint.—It is used exactly like white lead on new wood, plaster, stucco, metal, &c., only the workmen must be careful to wash the vessels or brushes previously used for white lead with spirits, not to keep the paint too thick, and to bear on the brush with less strength. The zinc being impalpable, grinding is not necessary. To paint with varnish, resin, or spirits, the zinc ought to be ground first in spirits of turpentine.

The siccative or dryer based on lead should not be used, but a manganesed drying oil, which is manufactured for this paint, must be added to it, in the proportion of from three to six per cent. of the oil used.

BIBLIOGRAPHICAL NOTICES.

The Progress of the Development of the Law of Storms, and of the Variable Winds, with Practical Application of the Subject to Navigation; illustrated by charts and wood cuts. By Lieut. Col. Reid, C. B., F. R. S. London: John Weale. 1849.

The theory maintained by Col. Reid in regard to the great storms being of a vortical nature has long attracted the attention of meteorologists and elicited much discussion. Whatever may be the correctness of the theory, its originator (Mr. Redfield) and himself deserve the credit of having earnestly labored to deduce practical value from it, and, if we are to believe the numerous and constantly increasing records of accidents encountered or avoided by vessels, with no little success. In the present volume additional details of great interest are given upon this subject, and the whole matter copiously illustrated by diagrams and charts, shewing the indications by which the commander may recognize the approach of a storm, its position in reference to him, and the direction of its progress, and the proper course to be pursued in order to avoid as far as possible its evil effects, as well as to shorten their voyages. It would appear that

the British Government and their marine are fully aware of the importance of these views, and that the French are following them in attention to the same subject. What part our own government officers may have taken, or may now be taking, in this most important inquiry, does not appear, but from its paramount value to our commerce, we suppose it cannot have escaped the practical attention either of Mr. Bache or Lieut. Maury, and by their assistance we may soon hope to see the subject still farther elucidated. F.

Chemical Experiments, Illustrating the Theory, Practice, and Application of the Science of Chemistry. By G. Francis, F. L. S. *A new and improved edition.* Philadelphia: Daniels & Smith. 1850.

This is a new, and claims to be an improved, edition of a very valuable and unpretending treatise. The "novelties and improvements" are somewhat hard to discover, for, upon a rapid comparison with the London edition of 1845, it appears to be an exact reprint, if not a mere re-issue, with a new title page. The treatise, however, has been written for the purpose of exciting and encouraging young experimenters to inquire into the apparent mysteries of chemistry, and contains a great number of well-devised and well-described experiments, the apparatus for, and method of, performing which are fully illustrated by plain wood cuts. The apparatus recommended is such as is, for the most part, cheap and easily procured, and in many cases can be made by the experimenter for himself. The experiments are, however, intended to be made on a small scale, the advantages of which the mothers of the novices, and others compelled to reside in the same houses with them, will no doubt duly appreciate. Besides these, the book contains descriptions of interesting processes, such as photography and the Daguerreotype, and recipes for the compounding of savory and comforting stomachic appliances, such as soda water, lemonade, and ginger beer, which being simply and in proper proportions set down, and without quackery, add decidedly to the value of the book. To those who will get it on our recommendation, it will prove a volume full of amusement and equally fraught with good instruction. F.

Documents relating to the Manufacture of Iron in Pennsylvania. Published on behalf of the Convention of Iron Masters, which met in Philadelphia on December 20, 1849.

We have had the pleasure of examining a volume of some 115 pages, sold by Lindsay & Blakiston, Philadelphia, bearing the above title, and deem it eminently worthy of a notice in our Journal. It contains a great amount of practical information on the state of the iron manufacture in our commonwealth, and some important details of the cost of producing the article both at home and abroad. A Convention of Iron Masters re-

siding in the State, which assembled in Philadelphia in 1849, appears to have authorized this publication by a general committee, and while our position compels us to abstain from the expression of any opinion on the purely political arguments contained in the memorial, &c., we deem it right to say, that a vast number of facts have been brought together by the committee which will furnish abundant matter for reflection to the political economists of both the free trade and protective schools. Additional value is given to the statistics furnished in the book, from the fact that the gentlemen compiling them are, almost without exception, actually engaged in the manufacture of iron. From the tables contained in our present number, and which by the kindness of the committee we are enabled to give to our readers, some idea may be formed of the magnitude and importance of the interest intended to be promoted by the dissemination of such matter. The whole book is well and lucidly prepared, and contains numerous diagrams and schedules, showing the great fluctuations to which both the domestic and foreign production are subject. We commend it to the perusal of our readers generally, and have no doubt that it will yield them the same pleasure we have enjoyed in following the committee through their luminous array of facts and figures. F.

Explanations referring to the following Tables.

* * * The facts thus collected are contained in a condensed form in the following fifteen tabular statements, the first eight of which comprise all the works in the State east of the Allegheny Mountain, and the last seven those west of that mountain. The results shown by the tables may be briefly summed up as follows:

The total number of counties in the State is . .	62
Of these the number now containing Iron Works is .	42
The number containing no Iron Works, . . .	17

Of these seventeen counties, however, nine contain abundance of iron ore and coal, but owing to the absence of any cheap road to market, they yet remain untouched, leaving only eight counties, of sixty-two in the State, not suited to the manufacture of iron.

Production of Iron from the Ore.

The following table shows the number of Furnaces of each sort and of Bloomeries in the State; the capital invested in land, buildings, and machinery; their present capacity; the actual make in 1847 and 1849, and the probable make of 1850, respectively.

		No.	Investment.	Present capacity. Tons.	Make 1847. Tons.	Make 1849. Tons.	Make 1850. Tons.
Blast furnaces using	Anthracite Coal,	57	$3,221,000	221,400	151,331	109,168	81,351
	Bituminous Coal,	7	223,000	12,600	7,800	4,900	3,900
	Coke,	4	800,000	12,000	10,000		
	Charcoal hot blast,	85	3,478,500	130,705	94,519	58,302	42,555
	" cold "	145	5,170,376	173,654	125,155	80,665	70,727
	Bloomeries,	6	28,700	600	545	335	280
	Totals,	304	$12,921,576	550,959	389,350	253,370	198,813

Conversion of Cast into Wrought Iron.

The following table shows the number of Forges and Rolling Mills in the State; the investment in lands, buildings, and machinery; the total number of converting fires and their capacity per annum, and their make in 1847 and 1849.

	No. works.	Investment.	No. forging fires.	No. puddling furnaces.	Capacity. Tons.	Actual make 1847. Tons.	Actual make 1849. Tons.
Charcoal forges,	121	$2,026,300	402		50,250*	39,997	28,495
Rolling Mills,	79	5,554,200		436	174,400†	163,760	108,358
Totals,	200	$7,580,500	402	436	224,650	203,727	136,853

* 402 fires at 125 tons per fire per annum.
† 436 furnaces at 400 tons per furnace per annum.

The total number of Nail Machines in the State is 606. The annual production of each machine averages 1000 kegs of 100 lbs. each, making 606,000 kegs, or 30,300 tons a year. Of the product of the Forges two-thirds are sold in the form of blooms to the Rolling Mills, and are manufactured into boiler plates, horse shoe rods, and bars for the manufacture of scythes, axes, edge tools, and cutlery, and other articles requiring a high polish. The remaining one-third is sold in the form of hammered bar iron in competition with Swedish and Russian iron.

The Conversion of Iron into Steel.

The following is a list of all the Works in the State engaged in the conversion of Steel:

	County.	Situation of Works.	Owners.	Amount annually converted. Tons.
Eastern Penn'a.	Philadelphia,	Kensington,	Jas. Rowland & Co.,	600
	"	"	J. Robbins,	500
	"	"	Earp & Brink,	100
	"	"	Robert S. Johnson,	400
	"	Oxford,	W. & H. Rowland,	700
	Lancaster,	Martic,	R. & G. D. Coleman,	400
	York,	Castlefin,	R. W. & W. Coleman,	100
West'n Pa.	Allegheny,	Pittsburg,	Singer, Hartman & Co.,	700
	"	"	Coleman, Hailman & Co.,	800
	"	"	Jones & Quigg,	1,200
	"	"	Spang & Co.,	200
	"	"	G. & J. H. Schoenberger,	200
	"	"	S. McKelvy,*	178
			Total tons,	6,078

* These works have only been in operation six months. 44 tons of the above amount is cast steel.

The total number of Iron Works of all kinds in the State is	504
The capital invested in lands, buildings, and machinery,	$20,502,076
The number of men employed,	30,103
The number of horses employed,	13,562

The capital invested includes only such lands and buildings as belong to the Iron Master, and such as are directly dependent on the Iron Works for their value.

Thus the *value* of farms, grist and saw mills, and similar property, horses, wagons, tools, and the like, and the dwellings of workmen near large cities, are excluded, because, though belonging to the works, they have an independent value.

The value of all coal land has been also excluded, both for the reason just given, and because it is the custom throughout the State, with very few exceptions, to purchase coal delivered at the works. The capital, and men, and horses employed in mining and transporting this coal to the works, and in transporting the finished iron to market, have also been excluded from the above account, because sufficient data were not in my possession for more than a conjectural estimate.

More than one-half of the Anthracite Furnaces, and a portion of the Charcoal Furnaces, purchase their ore of the farmers in their vicinity, who dig it on their farms and haul it to the furnaces in the winter, and at other times when they are not more particularly occupied with their agricultural labors. There are other large and valuable ore banks in the State which belong to parties who work them and sell the ore to furnaces in their vicinity. The value of all these ore banks, and the number of laborers employed at them, are excluded from the above account, which comprises only such real estate as belongs to persons in the iron business, and is indispensably requisite to carry on such business—and the *number* of men and horses directly employed by them.

The number of men thus engaged, over and above those reported to me as in the pay of the Iron Manufacturers, may be very nearly approximated by reference to tables A and B. pages 89 and 91 in the communication of S. J. Reeves, Esq., on the elementary cost of making pig and bar iron. On the basis of these tables I have calculated the number of laborers not in the pay of the Iron Masters, but directly dependent on the Iron Works for support, to be 7081 for the Blast Furnaces, and 4432 for the Rolling Mills, Forges, &c.; making together 11,513 to be added to the number above stated, or a grand total of 41,616 men dependent on the iron business in the State. Allowing five persons to each laborer, we have a population of 208,080 persons, or about one-tenth of the entire population of the State, dependent on the manufacture of iron.

The *consumption of fuel* in all the Iron Works of the State in 1847 was as follows:

Anthracite coal, 483,000 tons, at an average value of $3 per ton,	$1,449,000
Bituminous coal, 9,007,600 bushels, at 5c.,	450,380
Wood, 1,490,252 cords, at $2,*	2,980,504
Total value,	$4,879,884

The *ton of iron* is always the gross ton of	2240 lbs.
Except *Blooms and Puddled Bar*, which are bought and sold by the Ankoney or double gross ton of	2464 "
And Nails, which are sold by the net ton of	2000 "
Anthracite Coal is sold by the gross ton	2240 "
Bituminous Coal by the bushel of	80 "

In the statement of the Blast Furnaces, in the column headed "kind of ore used,"

H signifies Brown Hematite ore.
M " Magnetic ore.
F " Fossiliferous Red Oxide or Fossil ore.
C " Argillaceous Carbonate.
B " Bog ore.

In the column headed "Blast—Tuyeres—Diam.," the figures represent the diameter of the blowing nozzles.

In the column headed "Pressure," the figures represent the pressure to the square inch in pounds avoirdupois.

In the column headed "Market,"

"E" means Philadelphia.
"W" " Pittsburg.
"H" " Home—or the vicinity of the works.

In the column headed "kind of metal made,"

1 signifies coarse grey or best foundry iron.
2 " close grey iron.
3 " mottled and white iron, or hard iron.

In some instances there are figures in the column headed "Situation, Post Office," where such occur they signify the distance of the works from the Post Office.

The Hot Blast Furnaces which have dates assigned them prior to 1830, were built for Cold Blast Furnaces, and have been since changed to Hot Blast.

* This value is intended to include the cost of converting into Charcoal, (the form in which it is generally consumed.) and delivering at the furnace. It would be equivalent to five cents a bushel as the average value of Charcoal.

STATEMENT, showing the number and condition of each sort of **IRON WORKS**, and the capital invested in the Land and Buildings in each County in EASTERN PENNSYLVANIA, in the year 1850.

COUNTY.	ANTHRACITE BLAST FURNACES.						CHARCOAL BLAST FURNACES. HOT BLAST.					COLD BLAST.					BLOOMERIES.			FORGES.			ROLLING MILLS.			TOTAL.		
	S.* F.	†Unfin'sd.	In.	Out.	Total.	Investment.	S.* F.	In.	Out.	Total No.	Investment.	S.* F.	In.	Out.	Total No.	Investment.	S.* F.	No.	Investment.	S.* F.	No.	Investment.	S.* F.	No.	Investment	S.* F.	No.	Investment.
1. Adams,					0					0				1	1	4,000		0			0			0			1	4,000
2. Blair,					0		4	4	4	8	283,000		4		4	275,000		0		2	14	314,000		1	50,000	6	27	922,000
3. Bedford,					0		1		2	2	25,000	1		1	1	10,000		0		2	3	18,000		0		4	6	53,000
4. Berks,			1		1	65,000	2	4		4	201,000	1	6	2	8	335,000		0		5	23	320,000		5	310,000	8	41	1,231,000
5. Bucks,		1	1		2	120,000				0					0			0			0			0			2	120,000
6. Bradford,					0					0					0			0			0			0			0	
7. Carbon,	1		1	1	2	15,000		1	1	2	80,000				0			4	11,700		2	12,800		0		1	10	119,500
8. Cumberland,					0		2	1	1	2	215,000	5		5	5	159,000		0		3	4	75,000		1	75,000	10	12	524,000
9. Columbia,	5		5	6	11	745,000	2	2	2	4	51,000	1	1		1	3,500		0		1	1	5,000	1	3	303,000	10	20	1,107,500
10. Chester,			1	2	3	300,000				0			2		2	200,000		0		1	6	106,000	2	14	642,200	3	25	1,248,200
11. Centre,					0		1	1	1	2	180,000	5	4	4	8	308,000		0		2	5	63,000	2	5	114,000	10	20	665,000
12. Clearfield,					0				1	1	84,000				0			0						0			1	84,000
13. Clinton,					0		1	1	2	3	195,000	2		2	2	10,000		0			1	15,000		0		1	6	220,000
14. Dauphin,	1			2	2	103,000	1	1	1	2	100,000	2	2		2	40,000		0			2	19,000	1	1	20,000	5	9	282,000
15. Delaware,					0					0					0			0			0			1	16,000		1	16,000
16. Franklin,					0		1	2		2	101,000	3	1	5	6	112,000		0		3	8	61,500	1	1	32,000	8	17	306,500
17. Huntingdon,					0		6	6	3	9	345,000	4	3	3	6	230,000		0		5	11	256,000	1	2	65,000	16	28	896,000
18. Juniata,					0					0					0			0			0			0			0	
19. Lehigh,			6	1	7	410,000			1	1	60,000	1		1	1	8,000		0			0			0		1	9	478,000
20. Lycoming,					0		1		1	1	25,000		1	1	2	50,000		0			3	28,000		2	47,500	1	8	150,500
21. Luzerne,			2	2	4	270,000		1		1	20,000				0			0			1	12,000	1	2	400,000	1	8	702,000
22. Lebanon,		1	1	1	3	195,000				0			2	1	3	420,000		0			3	70,000		0			9	685,000
23. Lancaster,	3	1	5	3	9	305,000		3	2	5	335,000		1	1	2	95,000		0		2	12	223,000		2	315,000	5	30	1,273,000
24. Mifflin,					0		3		4	4	95,000			1	1	10,000		0		2	2	60,000		0		5	7	165,000
25. Monroe,					0					0					0			1	15,000		0			0			1	15,000
26. Montgomery,	1		2	3	5	273,000				0				1	1	23,000		0		1	2	20,000		4	187,000	2	12	503,000
27. Northumberland,	1		1	1	2	120,000				0		1		1	1	20,000		0			1	6,000		0		2	4	146,000
28. Northampton,	1	1	2	1	4	260,000				0					0		1	1	2,000		0			1	35,000	2	6	297,000
29. Potter,					0					0					0			0			0			0			0	
30. Perry,					0		2		3	3	90,000	1		2	2	30,000		0		1	1	60,000		1	185,000	4	7	365,000
31. Pike,					0					0					0			0			0			0			0	
32. Philadelphia,					0					0					0			0			3	45,000	2	8	307,000	2	11	352,000
33. Susquehanna,					0					0					0			0			0			0			0	
34. Sullivan,					0					0					0			0			0			0			0	
35. Schuylkill,	1	1	1		2	40,000		2		2	53,500			1	1	14,000		0		4	6	127,000	1	1	20,000	6	12	254,500
36. Tioga,					0		1	1		1	20,000				0			0			0			1	5,000	1	2	25,000
37. Union,					0		2	1	2	3	31,000				0			0		1	1	6,000		0		3	4	37,000
38. Wayne,					0					0					0			0			0			0			0	
39. Wyoming,					0					0					0			0			0			0			0	
40. York,					0		2		5	5	278,000				0			0		1	3	90,000		0		3	8	368,000
	14	5	29	23	57	3,221,000	32	31	36	67	2,867,500	27	27	33	60	2,356,500	1	6	28,700	36	118	2,012,300	12	56	3,128,700	120	364	13,614,700

* Sold by the Sheriff, or failed, since 1840.

† On 2 of these furnaces the work has been suspended over a year. On 2 others the work will be completed, but they will not be blown in. The remaining furnace will be completed and blown in, as it will take the place of another one worn out.

The value of all coal land has been also excluded, both for the reason just given, and because it is the custom throughout the State, with very few exceptions, to purchase coal delivered at the works. The capital, and men, and horses employed in mining and transporting this coal to the works, and in transporting the finished iron to market, have also been excluded from the above account, because sufficient data were not in my possession for more than a conjectural estimate.

More than one-half of the Anthracite Furnaces, and a portion of the Charcoal Furnaces, purchase their ore of the farmers in their vicinity, who dig it on their farms and haul it to the furnaces in the winter, and at other times when they are not more particularly occupied with their agricultural labors. There are other large and valuable ore banks in the State which belong to parties who work them and sell the ore to furnaces in their vicinity. The value of all these ore banks, and the number of laborers employed at them, are excluded from the above account, which comprises only such real estate as belongs to persons in the iron business, and is indispensably requisite to carry on such business—and the *number* of men and horses directly employed by them.

The number of men thus engaged, over and above those reported to me as in the pay of the Iron Manufacturers, may be very nearly approximated by reference to tables A and B, pages 89 and 91 in the communication of S. J. Reeves, Esq., on the elementary cost of making pig and bar iron. On the basis of these tables I have calculated the number of laborers not in the pay of the Iron Masters, but directly dependent on the Iron Works for support, to be 7081 for the Blast Furnaces, and 4432 for the Rolling Mills, Forges, &c.; making together 11,513 to be added to the number above stated, or a grand total of 41,616 men dependent on the iron business in the State. Allowing five persons to each laborer, we have a population of 208,080 persons, or about one-tenth of the entire population of the State, dependent on the manufacture of iron.

The *consumption of fuel* in all the Iron Works of the State in 1847 was as follows:

Anthracite coal, 483,000 tons, at an average value of $3 per ton,	$1,449,000
Bituminous coal, 9,007,600 bushels, at 5c.,	450,380
Wood, 1,490,252 cords, at $2,*	2,980,504
Total value,	$4,879,884

The *ton of iron* is always the gross ton of 2240 lbs.
Except *Blooms and Puddled Bar*, which are bought and sold by the Ankoney or double gross ton of 2464 "
And Nails, which are sold by the net ton of 2000 "
Anthracite Coal is sold by the gross ton 2240 "
Bituminous Coal by the bushel of 80 "

In the statement of the Blast Furnaces, in the column headed "kind of ore used,"
H signifies Brown Hematite ore.
M " Magnetic ore.
F " Fossiliferous Red Oxide or Fossil ore.
C " Argillaceous Carbonate.
B " Bog ore.

In the column headed "Blast—Tuyeres—Diam.," the figures represent the diameter of the blowing nozzles.

In the column headed "Pressure," the figures represent the pressure to the square inch in pounds avoirdupois.

In the column headed "Market,"
"E" means Philadelphia.
"W" " Pittsburg.
"H" " Home—or the vicinity of the works.

In the column headed "kind of metal made,"
1 signifies coarse grey or best foundry iron.
2 " close grey iron.
3 " mottled and white iron, or hard iron.

In some instances there are figures in the column headed "Situation, Post Office," where such occur they signify the distance of the works from the Post Office.

The Hot Blast Furnaces which have dates assigned them prior to 1830, were built for Cold Blast Furnaces, and have been since changed to Hot Blast.

* This value is intended to include the cost of converting into Charcoal, (the form in which it is generally consumed,) and delivering at the furnace. It would be equivalent to five cents a bushel as the average value of Charcoal.

Land and Buildings in each County in EASTERN

FORGES.			ROLLING MILLS.			TOTAL.			Counties.
S.* F.	No.	Investment.	S.* F.	No.	Investment	S.* F.	No.	Investment.	
	0			0			1	4,000	1.
2	14	314,000		1	50,000	6	27	922,000	2.
2	3	18,000		0		4	6	53,000	3.
5	23	320,000		5	310,000	8	41	1,231,000	4.
	0			0			3	120,000	5.
	0			0			0		6.
	2	12,800		0		1	10	119,500	7.
3	4	75,000		1	75,000	10	12	524,000	8.
1	1	5,000	1	3	303,000	10	20	1,107,500	9.
1	6	106,000	2	14	642,200	3	25	1,248,200	10.
2	5	63,000	2	5	114,000	10	20	665,000	11.
				0			1	84,000	12.
	1	15,000		0		1	6	220,000	13.
	2	19,000	1	1	20,000	5	9	282,000	14.
	0			1	16,000		1	16,000	15.
3	8	61,500	1	1	32,000	8	17	306,500	16.
5	11	256,000	1	2	65,000	16	28	896,000	17.
	0			0			0		18.
	0			0		1	9	478,000	19.
	3	28,000		2	47,500	1	8	150,500	20.
	1	12,000	1	2	400,000	1	8	702,000	21.
	3	70,000		0			9	685,000	22.
2	12	223,000		2	315,000	5	30	1,273,000	23.
2	2	60,000		0		5	7	165,000	24.
	0			0			1	15,000	25.
1	2	20,000		4	187,000	2	12	503,000	26.
	1	6,000		0		2	4	146,000	27.
	0			1	35,000	2	6	297,000	28.
	0			0			0		29.
1	1	60,000		1	185,000	4	7	365,000	30.
	0			0			0		31.
	3	45,000	2	8	307,000	2	11	352,000	32.
	0			0			0		33.
	0			0			0		34.
4	6	127,000	1	1	20,000	6	12	254,500	35.
	0			1	5,000	1	2	25,000	36.
1	1	6,000		0		3	4	37,000	37.
	0			0			0		38.
	0			0			0		39.
1	3	90,000		0		3	8	368,000	40.
6	118	2,012,300	12	56	3,128,700	120	364	13,614,700	

* §

† The remaining furnace will be completed and blown in, as it is to

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mottled and white iron, or hard iron.

In some instances there are figures in the column headed "Situation, Post Office," where such occur they signify the distance of the works from the Post Office.

The Hot Blast Furnaces which have dates assigned them prior to 1830, were built for Cold Blast Furnaces, and have been since changed to Hot Blast.

* This value is intended to include the cost of converting into Charcoal, (the form in which it is generally consumed,) and delivering at the furnace. It would be equivalent to five cents a bushel as the average value of Charcoal.

COUNTY.	Sold by Sheriff, or failed, and date.	No. FURNACES. Unfin'sd.	In Blast.	Out of Blast.	Date of construction.	NAME OF WORKS.	SITUATION. P. O.	OWNERS.	LESSEES.	* Kind of Ore used.	Largest Product. Tons.	Actual make 1849. Tons.
ks,			1		1846	Henry Clay,	Reading,	Eckert & Bro.,	None.	H. M.	3,484	3,250
ks,		1	1		1848	Durham,	Durham,	Jos. Whitaker & Co.	"	"	3,840	3,840
umbia,	1843 S			1	1838†	Montour, 1	Danville,	Montour I. Co.	"	F.	3,135	
do.	1844 S			1	1839	" 2	"	"	"	"	4,042	
do.	1844 S		1		1839	" 3	"	"	"	"	3,523	1,953
do.			1		1846	" 4	"	"	"	"	6,449	6,449
do.	1842 S			1	1846	Franklin,	"	Jacob B. Maus & Co.	"	"	1,000	200
do.	1848 F			1	1840	Roaring Creek,	"	Trustees U. S. Bank,	"	"	2,000	
do.			1		1840	Columbia,	"	Geo. Patterson,	J. P. & J. Grove,	"	2,500	1,600
do.			2		1845	Iron Dale,	Bloomsburg,	Bloomsburg I. Co.	None.	"	10,200	8,132
do.				1	1845	Williamsburg,	Light Street,	M. McDowell,	"	"	1,200	800
do.				1	1847	Light Street,	"	Light Street I. Co.	"	"	1,000	550
bon,	1848 F		1		1838	Carbon,	Mauch Chunk,	J. Richards & Sons,	"	H. M.	1,500	1,500
do.				1	1826	Mauch Chunk,	"	Lehigh C. & N. Co.	"	"	4,052	
ster,				1	1845	Phœnix, 1	Phœnixville,	Reeves, Buck & Co.	"	"		1,534
do.			1		1845	" 2	"	"	"	"	3,910	3,910
do.				1	1847	" 3	"	"	"	"	4,718	2,581
phin,				1	1845	Harrisburg,	Harrisburg,	D. R. Porter,	"	H.	3,614	3,360
do.	1847 S			1	1834‡	Emeline,	Dauphin,	A. C. Bayard,	"	"	600	
gh,				1	1840	Crane, 1	Catasauqua,	Lehigh Crane I. Co.	"	H. M.	3,958	3,639
do.			1		1842	" 2	"	"	"	"	4,833	4,494
do.			1		1846	" 3	"	"	"	"	7,144	6,139
do.			1		1850	" 4	"	"	"	"		
do.			1		1850	" 5	"	"	"	"		
do.			1		1846	Allentown, 1	Allentown,	D. E. Wilson & Co.	"	"	5,000	4,200
do.			1		1847	" 2	"	"	"	"	5,000	4,200
rne,				1	1842	Lackawanna, 1	Scrantonia,	Scrantons & Platt,	"	F. C.	1,800	1,800
do.			1		1849	" 2	"	"	"	"	300	300
do.			1		1849	" 3	"	"	"	"	300	300
do.				1	1847	Jim Crack,	Wilkesbarre,	H. B. Renwick,	"	F.	1,300	
non,				1	1847	Lebanon, 1	Lebanon,	R. & G. D. Coleman,	"	M.	3,778	3,659
do.			1		1848	" 2	"	"	"	"	3,354	3,188
do.		1			1850	Cornwall,	Cornwall,	R. W. & W. Coleman,	"	"		
caster,			1		1848	Safe Harbor,	Safe Harbor,	Reeves, Abbott & Co.	"	H.	2,879	2,879
do.	1849 S			1	1844	Shawnee,	Columbia,	Wright & Nephew,	"	"	1,000	
do.	1849 S		1		1848	Cordelia,	"	Bryan & Longnecker,	"	"	700	250
do.	1842 S			1	1841§	Sarah Ann,	"	Jno. B. Hertzler,	D. R. Porter,	"	1,664	200
do.			1		1845	Henry Clay,	"	Jno. Haldeman,	None.	"	2,678	2,159
do.			1		1846	Chickiswalungo,	"	E. Haldeman & Co.	"	"	2,464	1,500
do.				1	1847	Donegal,	"	Eckert & Stein,	"	"	3,472	3,472
do.			1		1849	Marietta,	"	Shoenberger & Musselman,	"	"	3,763	3,763
do.		1			1850	"	"	"	"	"		
tgomery,			1		1845	Plymouth,	Conshohocken,	S. Colwell,	"	"	3,338	2,492
do.			1		1848	Merion,	"	Colwell & Co.	"	"	3,174	3,174
do.				1	1844	Spring Mill,	"	Est. Farr & Kunzi,	D. Reeves,	"	1,000	
do.				1	1850	Swede,	Philadelphia;	Potts & Jones,	None.	"		
do.	1849 S			1	1845	Wm. Penn,	Conshohocken,	Hitner, Reeves & Co.	"	"	3,120	2,044
nhumberland,			1		1846	Chulasky,	Chulasky,	S. R. Wood,	"	F.	4,000	3,500
do.	1846 S			1	1812	Shamokin,	Shamokin,	Claghorn, Richards & Co.	"	C. B. F.	1,380	
thampton,	1849 S		1		1842	S. Easton,	Easton,	Thomas & Mills,	"	H. M.	3,140	3,140
do.				1	1844	Glendon, 1	"	Chas. Jackson, Jr.	"	"	3,978	3,978
do.			1		1845	" 2	"	"	"	"	6,253	4,469
do.		1			1850	" 3	"	"	"	"		
uylkill,	1849 S		1		1838	Pioneer,	Pottsville,	The Greenwood Co.	Patterson, Richards & Co.	H. C.	1,742	570
do.		1				St. Clair,	St. Clair,	Burd Patterson,	None.	C.		
	14	5	29	23							151,331	109,168

* In the column of Ores, H. signifies Brown Hematite; M., Magnetic; F., Fossiliferous Red Oxyde; C., Carbonate; B

† Altered from Charcoal 1839. ‡ Altered from Charcoal 1848. § Altered from Charcoal 1845.

F WORKS.	SITUATION. P. O.	OWNERS.	
ay,	Reading,	Eckert & Bro.,	No
	Durham,	Jos. Whitaker & Co.	"
1	Danville,	Montour I. Co.	"
2	"	"	"
3	"	"	"
4	"	"	"
	"	Jacob B. Maus & Co.	"
reek,	"	Trustees U. S. Bank,	"
	"	Geo. Patterson,	J. P.
	Bloomsburg,	Bloomsburg I. Co.	No
burg,	Light Street,	M. McDowell,	"
eet,	"	Light Street I. Co.	"
	Mauch Chunk,	J. Richards & Sons,	"
unk,	"	Lehigh C. & N. Co.	"
1	Phœnixville,	Reeves, Buck & Co.	"
2	"	"	"
3	"	"	"
g,	Harrisburg,	D. R. Porter,	"
	Dauphin,	A. C. Bayard,	"
1	Catasauqua,	Lehigh Crane I. Co.	"
2	"	"	"
3	"	"	"
4	"	"	"
5	"	"	"
1	Allentown,	D. E. Wilson & Co.	"
2	"	"	"
na, 1	Scrantonia,	Scrantons & Platt,	"
2	"	"	"
3	"	"	"
	Wilkesbarre,	H. B. Renwick,	"
1	Lebanon,	R. & G. D. Coleman,	"
2	"	"	"
	Cornwall,	R. W. & W. Coleman,	"
or,	Safe Harbor,	Reeves, Abbott & Co.	"
	Columbia,	Wright & Nephew,	"
	"	Bryan & Longnecker,	"
	"	Jno. B. Hertzler,	D. R.
y,	"	Jno. Haldeman,	No
lungo,	"	E. Haldeman & Co.	"
	"	Eckert & Stein,	"
	"	Shoenberger & Musselman,	"
	"	"	"
	Conshohocken,	S. Colwell,	"
	"	Colwell & Co.	"
l,	"	Est. Farr & Kunzi,	D. Re
	Philadelphia;	Potts & Jones,	No
,	Conshohocken,	Hitner, Reeves & Co.	"
	Chulasky,	S. R. Wood,	"
	Shamokin,	Claghorn, Richards & Co.	"
	Easton,	Thomas & Mills,	"
1	"	Chas. Jackson, Jr.	"
2	"	"	"
3	"	"	"
	Pottsville,	The Greenwood Co.	Patter
	St. Clair,	Burd Patterson,	No

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* This value is intended to include the consumed.) and delivering at the furnace value of Charcoal.

ered from Charcoal 1839. ‡ Altered from Charcoal 1848.

...of FURNACES in the State of Pennsylvania, in the year 1850.

LESSEES.	* Kind of Ore used.	Largest Product.	Actual make 1849.	No. men and boys employed.	No. oxen, horses and mules employed.	BLAST.				STACK.		Kind of Power used, and No.	Kind of Metal made, and No.	Annual Capacity.
						Heat.	Tuyeres.		Pres'e.	Bosh. feet.	Height. feet.			
							No.	Diam.						
		Tons.	Tons.											Tons.
None.	H. M.	3,484	3,250	50	35	500°	3	3	3a4	14	37	Steam.	1	3,500
"	"	3,840	3,840	103	32	500	3	3	3	13	40	"	2, 3	8,000
"	F.	3,135		70	5	612	3	2¾	4	9	31	"	3	3,150
"	"	4,042		70	5	"	3	"	4½	12	33	"	3	4,100
"	"	3,523	1,953	70	5	"	3	"	"	"	"	"	3	4,100
"	"	6,449	6,449	70	5	"	4	"	4⅜	14	34	"	3	6,500
"	"	1,000	200	45	25	"	3	4	2	8	30	"	2, 3	2,000
"	"	2,000		45	45	"	3	3	3	8½	32	Water.	1, 2	2,000
J. P. & J. Grove,	"	2,500	1,600	50	20	"	3	2½	5	8½	30	Steam.	1, 2	2,500
None.	"	10,200	8,132	180	80	550	3	3¾	2½	14	35	Water.	2, 3	10,200
"	"	1,200	800	40	25	500	3	3	1½	8	30	"	2, 3	2,000
"	"	1,000	550	40	20	"	3	2½	1¾	9	32	"	2, 3	2,000
"	H. M.	1,500	1,500	53	8	"	3	3	3	8½	34	"	1, 2	2,000
"	"	4,052								8	28	"		2,000
"	"		1,534			612	3	3	4	12	38	Steam.	2, 3	4,100
"	"	3,910	3,910	371	114	612	3	3	4	12	"	"	2, 3	4,100
"	"	4,718	2,581			"	3	3	4	14	"	"	2, 3	5,000
"	H.	3,614	3,360	71	48	"	3	3½	3¾	12	35	"	1, 2	3,800
"	"	600		30	7	"	3	2⅝	2½	8	"	S & W.	"	2,000
"	H. M.	3,958	3,639		300	"	3	3	4	11	45	Water.	"	4,000
"	"	4,833	4,494	500		"	4	"	"	13	"	"	"	5,000
"	"	7,144	6,139			"	6	"	"	17	"	Steam.	"	7,200
"	"					"	7	"	"	18	40	"	"	8,000
"	"					"	7	"	"	18	"	"	"	8,000
"	"	5,000	4,200	200	250	"	3	2¾	2½a3	12	35	"	"	5,000
"	"	5,000	4,200			"	3	"	2½a3	12	35	"	"	5,000
"	F. C.	1,800	1,800		225	450	3	2½	2	11	33	Water.	3	2,000
"	"	300	300	500		"	3	3½	2½	14	35	Steam.	3	3,500
"	"	300	300			"	3	3½	"	14	35	"	3	3,500
"	F.	1,300		50	20	"	3	2½	1	9	33	"	3	1,500
"	M.	3,778	3,659	213	100	"	3	4	4	14	35	"	1, 2, 3	6,000
"	"	3,354	3,188			"	3	5	4	12	35	"	"	5,000
"	"					"	3	4		12	38	"	"	5,000
"	H.	2,879	2,879	100	34	"	6	3½	3¾	14	45	"	3	5,000
"	"	1,000		28	60	"	2	4		8	28	"	1, 2	2,000
"	"	700	250	28	71	612	3	3		8½	31	"	"	2,000
D. R. Porter,	"	1,664	200	24	30	"	3	3	3½	8	30	"	"	2,000
None.	"	2,678	2,159	50	36	"	3	3½	2¾	9	35	"	"	2,800
"	"	2,464	1,500	45	40	"	3	3	2½	8	32	"	1, 2, 3	2,500
"	"	3,472	3,472	46	44	"	3	3	4	10	35	"	"	3,800
"	"	3,763	3,763	58	45	"	3	3½	3½	10	33	"	"	3,800
"	"					"	3	"	"	10	33	"	"	3,800
"	"	3,338	2,492	185	40	"	3	3	3	11	36	"	1, 2	3,350
"	"	3,174	3,174	120	40	"	3	3	3½	14	38	"	"	3,500
D. Reeves,	"	1,000		100	40	"	3	3	4	12	40	"	3, 4	4,000
None.	"			110	20	"	6	2½	4	14	42	"	1, 2	4,000
"	"	3,120	2,044	95	42	"	6	2¼	2½	13	33	"	"	3,500
"	F.	4,000	3,500	65	50	"	3	4	3½	14	34	"	2, 3	4,500
"	C. B. F.	1,380		40	25	"	3	3	4¼	12	45	"	1, 2	3,500
"	H. M.	3,140	3,140	50	20	"	3	2¾	3½	11	37	Water.	"	3,500
"	"	3,978	3,978	200	90	500	3	3	3	10	45	"	1, 2, 3	4,000
"	"	6,253	4,469			"	4	"	"	12	45	"	"	6,300
"	"					"	5	"	"	12	35	Steam.	"	6,300
Patterson, Richards & Co.	H. C.	1,742	570	60	25	612	3	3	4	9	34	"	1	2,000
None.	C.					"	3			14	32	"	1, 2	3,500
		151,331	109,168	4,225	2,126									221,400

etic; F., Fossiliferous Red Oxyde; C., Carbonate; B., Bog Ore.

al 1848. § Altered from Charcoal 1845.

A Detailed Statement of all the HOT BLAST CHARCOAL FURNACES IN EASTERN PENNSYLVANIA, in the

COUNTY.	Sold by Sheriff, or failed.	No. Furnaces. In Blast.	No. Furnaces. Out Blast.	Date of construction.	NAME OF WORKS.	SITUATION. POST OFFICE.	OWNERS.	LESSEES.	Kind of Ores used.	Largest Product. Tons.	Actual make in 1849. Tons.	No. of men and boys employed.	No. oxen, horses and mules employed.
Blair,	1849 S		1	1836	Elizabeth,	Frankstown,	Samuel Good & Co.		F.	1,000		100	25
do.		1		1815	Springfield,	Springfield Furnace,	Royer & Co.		F. & H.	1,820	1,560	80	50
do.	1850 S		1	1846	Gap,	E. Freedom,	Ed. F. Shoenberger,		F. & H.	1,260	1,260	45	43
do.		1		1811	Alleghany,	Hollidaysburg,	Elias Baker,		H.	1,751	1,062	80	60
do.		1		1846	Blair,	Collinsville,	H. McNeall,		F. & ½ H.	911	911	76	27
do.			1	1832	Elizabeth,	Antestown,	Martin Bell,		H.	883	554	50	20
do.	1850 F	1		1805	Ætna,	Yellow Spring,	Spang, Keller & Co.		F. H.	1,000	1,000	100	38
do.	1850 F		1	1837	Canoe,	Williamsburg,	"		H.	1,180			
Bedford,	S		1	1800	Hopewell,	Hopewell,	McDowell, Benedict and others,		F.	500	300	50	20
do.			1	1846	Hanover,	McConnelsburg,	John Potts,		H.	300		50	25
Berks,	1842 F	1		1777	Reading,	Furnace,	H. P. Robeson & Co.		M.	2,200	1,800	100	80
do.		1		1846	Hampton,	Hampton,	E. & George Brooke,		M.	1,550	1,550	50	30
do.		1		1836	Alsace,	Reading,	Clymer, Kaufman & Co.		H.	850	450	40	40
do.	1842 S	1		1820	Windsor,	Mohrsville,	Darrach & Jones,		H.	1,200	900	50	50
Carbon,		1		1834	Maria,	Lehighton, 2 m.	Thos. M. Smith & Est. T. S. Richards,		H.	2,059	1,884	153	58
do.			1	1837	Pennsville,	E. Penn,	S. Balliet & Co.		H.	780	624	61	55
Cumberland,	1837 S	1		1770	Pine Grove,	Carlisle,	Wm. M. Watts,		H.	1,600	500	61	41
do.	1849 S		1	1795	Holley,	Papertown,	Farmers and Mechanics Bank,		M. & H.	800	350	70	40
Columbia,	1848 S		1	1839	Liberty,	Mooresburg,	Trustees U. S. Bank,		F.	1,000		80	30
do.		1		1836	Esther,	Catawissa, 3½,	S. B. Deemer,		F.	1,600	900	60	50
do.		1		1845	Penn,	Catawissa, ¾,	Fincher & Thomas,		F.	854	854	70	60
do.	1849 S		1	1837	Briar Creek,	Berwick, 2,	Charles Kalbfus,		F.	680	275	30	15
Centre,		1		1790	Centre,	Bolesberry,	Thompson, McCoy & Co.		H.	1,400	1,200	75	50
do.	1849 S		1	1826	Hecla,	Zion,	Boyd & Cummings,		H.	1,000		60	18
Clearfield,			1	1815	Karthaus,*	K.,	P. A. Karthaus, Jr.		C.	1,820		120	20
Clinton,	1849 S	1		1830	Mill Hall,	Mill Hall,	Wharton, Morris & Co.		H.	1,360	1,360	70	45
do.			1	1811	Washington,	Kittany,	John Henderson,	W. Morris & Co.	H.	1,100		70	45
do.			1	1834	Farrandsville,*	Farrandsville,	John O. Stearns,		F.	1,100		70	25
Dauphin,	1847 S		1	1830	Victoria,	Dauphin,	A. C. Bayard,		H.	2,200		90	80
do.		1		1837	Manada,	W. Hanover,	E. & C. B. Grubb,	Grubb & Kintzer.	M.	2,215	1,800	100	70
Franklin,	1842 F	1		1805	Montalto,	Montalto,	H. & H. Hughes,		H.	1,000	1,000	150	30
do.		1		1837	Caledonia,	Grafenburg, Adams Co.	Thaddeus Stevens,		H.	800	750	80	34
Huntingdon,	1849 S	1		1844	Monroe,	Pine Grove, Centre Co.	James Irvin,		H. & F.	900	900	60	30
do.	S	1		1838	Mill Creek,	Mill Creek,	Irvin, Green & Co.		⅘ H. & ⅕ F.	1,367	1,367	70	40
do.	S	1		1816	Union,	Spruce Cr.,	Wallace's Heirs,	G. W. Patton & Co.	H.	1,200	800	60	25
do.			1	1796	Huntingdon,	Warrior's Mark,	George K. Shoenberger,		H.	1,650	1,100	130	50
do.		1		1839	Edward,	Vineyard Mills,	Samuel H. Bell,		F. & H.	960	575	50	36
do.	S		1	1832	Winchester,	Orbisonia,	T. T. Cromwell,	J. Wigton & Co.	H.	500	500	40	30
do.	S	1		1830	Rockhill,	"	Isett, Wighton & Co.		F. & H.	850	850	40	34
do.	S		1	1837	Chester,	"	Pennock's Heirs,		H.	500		80	24
do.		1		1849	Rough and Ready,	Coffee Run,	James Entricken,	Wigton & Moore.	F. & ½ H.	357	357	48	27
Lehigh,			1	1826	Lehigh,	N. Whitehall,	S. Balliet & Co.		H.	1,430	1,204	90	60
Lycoming,	1843 S		1	1837	Ralston,	Ralston,	Lycoming Valley Iron Co.		C.	1,000		44	37
Luzerne,		1		1846	Shickshinny,	Shickshinny,	Wilson & Koons,		F.	1,600	1,600	62	24
Lancaster,		1		1756	Elizabeth,	Brickerville,	R. & G. D. Coleman,		M.	1,900	1,500	60	50
do.		1	1	1832	Rock,†	Peningtonville,	Charles Brooks, Jr., & Co.		H.	1,156	1,051	100	90
do.			1	1800	Mount Vernon,	Elizabethtown,	E. & C. B. Grubb,		M.	1,300		100	30
do.		1		1809	Conowingo,	Buck,	James M. Hopkins,		H.	1,300	870	100	75
Mifflin,			1	1846	Isabella,	Lewistown,	A. B. Long,		F. & H.	1,300		55	40
do.	S		1	1810	Hope,	Lewistown, 6 m.	D. W. Hewling,		F. & H.	1,000	1,000	55	30
do.	1849 S		1	1838	Brookland,	Waynesburg,	H. N. Burroughs,		H.	1,200		100	40
do.	1847 F		1	1838	Matilda,	Jackstown P. O. Huntingd'n Co.	J. F. Cottrell,		F.	1,200	800	60	30
Perry,	1847 S		1	1840	Perry,‡	Bloomfield,	Loy, Everhart & Co.		F. & H.	500		40	35
do.	1849 S		1	1808	Juniata,	Newport, 3 m.	Cathcart & Co.		F. & H.	800	400	50	30
do.			1	1836	Montebello,	Duncannon,	Fisher, Morgan & Co.		F.	1,449	1,185	70	35
Schuylkill,		1		1830	Swatara,§	Pine Grove, 6 m.	Eckert & Guilford,		M.	1,880	1,300	103	33
do.		1		1835	Stanhope,	Pine Grove, 2 m.	W. S. & J. R. Breitenbach,		H.	788	788	65	38
Tioga,	1849 F	1		1841	Blossburg,	Blossburg,	James H. Gulick,		F. C. B.	700	700	40	16
Union,	S		1	1827	Berlin,	Hartleytown, 4 m.	C. & C. Brooke,		F.	900		60	30
do.	1848 S		1	1846	Forest,	Milton, 6 m.	Kaufman, Reber & Co.		F.	700		36	20
do.		1		1848	Beaver,	Middleburg,	Middleswarth, Kerns & Co.		F.	1,200	1,200	50	36
York,	1842 S		1	1823	Margaretta,	Margaretta,	Hahn & Himes,	Curran, Himes & Co.	H.	1,100	745	100	30
do.			1	1827	Manor,	Chanceford,	John Herr,		H.	1,000	100	80	40
do.			1	1830	York,	Chanceford,	John Bair,		H.	1,000	700	80	30
do.			1	1836	Codorus,	Manchester,	E. & C. B. Grubb,		H.	2,400	1,900	100	30

A Detailed Statement of all the HOT BLAST CHARCOAL FURNACES IN EASTERN PENNSYLVANIA, in the y

COUNTY.	Sold by Sheriff, or failed.	No. Furnaces. In Blast.	No. Furnaces. Out Blast.	Date of construction.	NAME OF WORKS.	SITUATION. POST OFFICE.	OWNERS.	LESSEES.	Kind of Ores used.	Largest Product. Tons.	Actual make in 1849. Tons	No. of men and boys employed.	No. oxen, horses and mules employed.
Blair,	1849 S		1	1836	Elizabeth,	Frankstown,	Samuel Good & Co.		F.	1,000		100	25
do.		1		1815	Springfield,	Springfield Furnace,	Royer & Co.		F. & H.	1,820	1,560	80	50
do.	1850 S		1	1846	Gap,	E. Freedom,	Ed. F. Shoenberger,		F. & H.	1,260	1,260	45	43
do.		1		1811	Alleghany,	Hollidaysburg,	Elias Baker,		H.	1,751	1,062	80	60
do.		1		1846	Blair,	Collinsville,	H. McNeall,		F. & ½ H.	911	911	76	27
do.			1	1832	Elizabeth,	Antestown,	Martin Bell,		H.	883	554	50	20
do.	1850 F	1		1805	Ætna,	Yellow Spring,	Spang, Keller & Co.		F. H.	1,000	1,000	100	38
do.	1850 F		1	1837	Canoe,	Williamsburg,	"		H.	1,180			
Bedford,	S		1	1800	Hopewell,	Hopewell,	McDowell, Benedict and others,		F.	500	300	50	20
do.			1	1846	Hanover,	McConnelsburg,	John Potts,		H.	300		50	25
Berks,	1842 F	1		1777	Reading,	Furnace,	H. P. Robeson & Co.		M.	2,200	1,800	100	80
do.		1		1846	Hampton,	Hampton,	E. & George Brooke,		M.	1,550	1,550	50	30
do.		1		1836	Alsace,	Reading,	Clymer, Kaufman & Co.		H.	850	450	40	40
do.	1842 S	1		1820	Windsor,	Mohrsville,	Darrach & Jones,		H.	1,200	900	50	50
Carbon,		1		1834	Maria,	Lehighton, 2 m.	Thos. M. Smith & Est. T. S. Richards,		H.	2,059	1,884	153	58
do.			1	1837	Pennsville,	E. Penn,	S. Balliet & Co.		H.	780	624	61	55
Cumberland,	1837 S	1		1770	Pine Grove,	Carlisle,	Wm. M. Watts,		H.	1,600	500	61	41
do.	1849 S		1	1795	Holley,	Papertown,	Farmers and Mechanics Bank,		M. & H.	800	350	70	40
Columbia,	1848 S		1	1839	Liberty,	Mooresburg,	Trustees U. S. Bank,		F.	1,000		80	30
do.		1		1836	Esther,	Catawissa, 3½,	S. B. Deemer,		F.	1,600	900	60	50
do.		1		1845	Penn,	Catawissa, ¾,	Fincher & Thomas,		F.	854	854	70	60
do.	1849 S		1	1837	Briar Creek,	Berwick, 2,	Charles Kalbfus,		F.	680	275	30	15
Centre,		1		1790	Centre,	Bolesberry,	Thompson, McCoy & Co.		H.	1,400	1,200	75	50
do.	1849 S		1	1826	Hecla,	Zion,	Boyd & Cummings,		H.	1,000		60	18
Clearfield,			1	1815	Karthaus,*	K.,	P. A. Karthaus, Jr.		C.	1,820		120	20
Clinton,	1849 S	1		1830	Mill Hall,	Mill Hall,	Wharton, Morris & Co.		H.	1,360	1,360	70	45
do.			1	1811	Washington,	Kittany,	John Henderson,	W. Morris & Co.	H.	1,100		70	45
do.			1	1834	Farrandsville,*	Farrandsville,	John O. Stearns,		F.	1,100		70	25
Dauphin,	1847 S		1	1830	Victoria,	Dauphin,	A. C. Bayard,		H.	2,200		90	80
do.		1		1837	Manada,	W. Hanover,	E. & C. B. Grubb,	Grubb & Kintzer.	M.	2,215	1,800	100	70
Franklin,	1842 F	1		1805	Montalto,	Montalto,	H. & H. Hughes,		H.	1,000	1,000	150	30
do.		1		1837	Caledonia,	Grafenburg, Adams Co.	Thaddeus Stevens,		H.	800	750	80	34
Huntingdon,	1849 S	1		1844	Monroe,	Pine Crove, Centre Co.	James Irvin,		H. & F.	900	900	60	30
do.	S	1		1838	Mill Creek,	Mill Creek,	Irvin, Green & Co.		⅔ H. & ⅓ F.	1,367	1,367	70	40
do.	S	1		1816	Union,	Spruce Cr.,	Wallace's Heirs,	G. W. Patton & Co.	H.	1,200	800	60	25
do.			1	1796	Huntingdon,	Warrior's Mark,	George K. Shoenberger,		H.	1,650	1,100	130	50
do.		1		1839	Edward,	Vineyard Mills,	Samuel H. Bell,		F. & H.	960	575	50	36
do.	S		1	1832	Winchester,	Orbisonia,	T. T. Cromwell,	J. Wigton & Co.	H.	500	500	40	30
do.	S	1		1830	Rockhill,	"	Isett, Wighton & Co.		F. & H.	850	850	40	34
do.	S		1	1837	Chester,	"	Pennock's Heirs,		H.	500		80	24
do.		1		1849	Rough and Ready,	Coffee Run,	James Entricken,	Wigton & Moore.	F. & ½ H.	357	357	48	27
Lehigh,			1	1826	Lehigh,	N. Whitehall,	S. Balliet & Co.		H.	1,430	1,204	90	60
Lycoming,	1843 S		1	1837	Ralston,	Ralston,	Lycoming Valley Iron Co.		C.	1,000		44	37
Luzerne,		1		1846	Shickshinny,	Shickshinny,	Wilson & Koons,		F.	1,600	1,600	62	24
Lancaster,		1		1756	Elizabeth,	Brickerville,	R. & G. D. Coleman,		M.	1,900	1,500	60	50
do.		1	1	1832	Rock,†	Peningtonville,	Charles Brooks, Jr., & Co.		H.	1,156	1,051	100	90
do.			1	1800	Mount Vernon,	Elizabethtown,	E. & C. B. Grubb,		M.	1,300		100	30
do.		1		1809	Conowingo,	Buck,	James M. Hopkins,		H.	1,300	870	100	75
Mifflin,			1	1846	Isabella,	Lewistown,	A. B. Long,		F. & H.	1,300		55	40
do.	S		1	1810	Hope,	Lewistown, 6 m.	D. W. Hewling,		F. & H.	1,000	1,000	55	30
do.	1849 S		1	1838	Brookland,	Waynesburg,	H. N. Burroughs,		H.	1,200		100	40
do.	1847 F		1	1838	Matilda,	Jackstown P. O. Huntingd'n Co.	J. F. Cottrell,		F.	1,200	800	60	30
Perry,	1847 S		1	1840	Perry,‡	Bloomfield,	Loy, Everhart & Co.		F. & H.	500		40	35
do.	1849 S		1	1808	Juniata,	Newport, 3 m.	Cathcart & Co.		F. & H.	800	400	50	30
do.			1	1836	Montebello,	Duncannon,	Fisher, Morgan & Co.		F.	1,449	1,185	70	35
Schuylkill,		1		1830	Swatara,§	Pine Grove, 6 m.	Eckert & Guilford,		M.	1,880	1,300	103	33
do.		1		1835	Stanhope,	Pine Grove, 2 m.	W. S. & J. R. Breitenbach,		H.	788	788	65	38
Tioga,	1849 F	1		1841	Blossburg,	Blossburg,	James H. Gulick,		F. C. B.	700	700	40	16
Union,	S		1	1827	Berlin,	Hartleytown, 4 m.	C. & C. Brooke,		F.	900		60	30
do.	1848 S		1	1846	Forest,	Milton, 6 m.	Kaufman, Reber & Co.		F.	700		36	20
do.		1		1848	Beaver,	Middleburg,	Middleswarth, Kerns & Co.		F.	1,200	1,200	50	36
York,	1842 S		1	1823	Margaretta,	Margaretta,	Hahn & Himes,	Curran, Himes & Co.	H.	1,100	745	100	30
do.			1	1827	Manor,	Chanceford,	John Herr,		H.	1,000	100	80	40
do.			1	1830	York,	Chanceford,	John Bair,		H.	1,000	700	80	30
do.			1	1836	Codorus,	Manchester,	E. & C. B. Grubb,		H.	2,400	1,900	100	30
do.	1842 S		1	1842	Woodstock,	Margaretta,	Hahn & Himes.	Curran, Himes & Co.	H.	1,000		75	20
	32	31	36							77,860	46,336	4,694	2,499

* Built for a Coke Furnace. † Now running Cold Blast. ‡ Abandoned. § Blast now running Cold,

IN EASTERN PENNSYLVANIA, in the year 1850.

COUS.	Kind of Ores used.	Largest Product. Tons.	Actual make in 1849. Tons	No. of men and boys employed.	No. oxen, horses and mules employed.	BLAST. Heat.	Tuyeres No.	Tuyeres Diam.	Pressure.	STACK. Bosh. feet.	Height. feet.	Kind of Power used.	Kind of Metal made. No.	Market for sales.	Capacity. Tons.
Blair,	F.	1,000		100	25	Hot.	2			8½	32	W.&S.	3	W.	1,600
do.	F. & H.	1,820	1,560	80	50	"	2			8	30	Water.	3	"	1,820
do.	F. & H.	1,260	1,260	45	43	"	1	2½		8½	32	"	3	"	1,600
do.	H.	1,751	1,062	80	60	"	2	2½		9	32	"	1, 2, 3	"	1,800
do.	F. & ½ H.	911	911	76	27	"	2	2½		8	36	Steam.	3	W. & H.	1,400
do.	H.	883	554	50	20	"	2	2½		8½	34	Water.	3	W.	1,600
do.	F. H.	1,000	1,000	100	38	"	1	2½		8	31	"	3	"	1,400
do.	H.	1,180				"	2	2½		8	31	Steam.	3	"	1,400
Bedford,	F.	500	300	50	20	"	1			7	32	Water.	3	E. & W.	1,000
do.	H.	300		50	25	"	2	2½		7	30	"		H.	1,000
Berks,	M.	2,200	1,800	100	80	"	2	2	1½	9	30	"	2, 3		2,200
do.	M.	1,550	1,550	50	30	"	2	2¾	1	7½	30	"	2, 3		1,200
do.	H.	850	450	40	40	"	1	2		7½	30	"	1, 2, 3		1,550
do.	H.	1,200	900	50	50	"	2	3		7½	30	"			1,200
Carbon,	H.	2,059	1,884	153	58	600°	1		3	8	30	"	1		2,060
do.	H.	780	624	61	55	500°	1	2½		7	30	"	1		1,000
Cumberl	H.	1,600	500	61	41	Warm	2	2½		8	33	"	1		1,600
do.	M. & H.	800	350	70	40	"	2	2½		8	33	"	2, 3		1,400
Columbi	F.	1,600		80	30	Hot.	2	2½		8	30	Steam.	1, 2		1,400
do.	F.	1,600	900	60	50	"	2	2½		7½	30	Water.	2, 3		1,600
do.	F.	854	854	70	60	"	2	3		7½	29	"	2, 3		1,200
do.	F.	680	275	30	15	"	2	2½ & 2¾		7	27	"	2, 3		1,000
Centre,	H.	1,400	1,200	75	50	"	2	3		8	30	"	3		1,400
do.	H.	1,000		60	18	"	1	2½		8	30	"	3		1,400
Clearfiel	C.	1,820		120	20	400°	3	2½	2	12	45	"	3		2,000
Clinton,	H.	1,360	1,360	70	45	Hot.	2	4		8½	28	"	2, 3		1,600
do. Co.	H.	1,100		70	45	"	1			8	30	"	2, 3		1,400
do.	F.	1,100		70	25	"	2			10	45	"	2, 3		2,000
Dauphin,	H.	2,200		90	80	"	2	2½ & 3		9	45	"	1, 2		2,200
do. ıtzer.	M.	2,215	1,800	100	70	600°	2	2½	1¾	8½	32	"	3		2,215
Franklin,	H.	1,000	1,000	150	30	Hot.	2	2½ *a* 3		9	33	"	2, 3		1,800
do.	H.	800	750	80	34	"	2	2 *a* 3		8	33	"			1,400
Huntingc	H. & F.	900	900	60	30	"	2	2		9	33	"	1, 2, 3		1,800
do.	⅔ H. & ⅓ F.	1,367	1,367	70	40	"	1	2¾		8	30	"	3	E. & W.	1,400
do. n & Co.	H.	1,200	800	60	25	"	1	2½		8	30	"	2, 3	E. & W.	1,400
do.	H.	1,650	1,100	130	50	"	1	2½		8½	33	"	3	W.	1,650
do.	F. & H.	960	575	50	36	"	2	2		8½	32	"	2, 3	W.	1,600
do. Co.	H.	500	500	40	30	"	1	2½		8	28	"	2, 3	W.	1,400
do.	F. & H.	850	850	40	34	"	2	2½		8	30	"	3	E.	1,400
do.	H.	500		80	24	"	2			9	45	S.&W.	2, 3	E.	1,800
do. oore.	F. & ½ H.	357	357	48	27	"	2	2½		9	32	Water.	3	E.	1,800
Lehigh,	H.	1,430	1,204	90	60	500°	1	2¾		7½	31	"	1		1,200
Lycomin	C.	1,000		44	37	600°	3	3¼		10	35	"	2		2,000
Luzerne,	F.	1,600	1,600	62	24	Hot.	2	2		9	30	"	1, 2		1,800
Lancaste	M.	1,900	1,500	60	50	460°	2	1½	1	9	29	S.&W.	1, 2, 3		1,900
do.	H.	1,156	1,051	100	90	"	2	2	1½	8½	29	"	1, 2, 3		1,200
do.	M.	1,300		100	30		2	2½		8	32	"	2, 3		1,400
do.	H.	1,300	870	100	75	212°	1	3		7½	30	"	1, 2		1,200
Mifflin,	F. & H.	1,300		55	40	Hot.	2	2¾		9	30	"	1, 2	E.	1,800
do.	F. & H.	1,000	1,000	55	30	"	2	2½		8½	31	"			1,600
do.	H.	1,200		100	40	"	2	3		8	32	"	2, 3	E.	1,400
do.	F.	1,200	800	60	30	"	2	2½		8	33	Steam.	1, 2	E.	1,400
Perry,	F. & H.	500		40	35	"	1			7		Water.	1, 2		1,000
do.	F. & H.	800	400	50	30	"	2			8		"	1, 2		1,400
do.	F.	1,449	1,185	70	35	"	2	1½		8½	32	"	2, 3		1,600
Schuylkil	M.	1,880	1,300	103	33	Cold.	2	2½		9	32	"	1, 2		1,880
do.	H.	788	788	65	38	Hot.	1	2½		7½	30	"	1, 2		1,200
Tioga,	F. C. B.	700	700	40	16	400°	1	4		7½	31	"	1, 2		1,200
Union,	F.	900		60	30	Hot.	2			8	31	"	2, 3		1,400
do.	F.	700		36	20	"	2			9	30	"	1, 2		1,800
do.	F.	1,200	1,200	50	36	"	2	2¾		8½	30	"	1, 2		1,600
York, es & Co.	H.	1,100	745	100	30	"	2	2 & 3		7	32	Steam.	1, 2		1,200
do.	H.	1,000	100	80	40	"	1	2		8	32	Water.	1, 2		1,400
do.	H.	1,000	700	80	30	"	2	2½		9	32	"	1, 2		1,800
do.	H.	2,400	1,900	100	30	"	2	3		8	32	"	1, 2		1,400
do. es & Co.	H.	1,000		75	20	"	2			10	40	"			2,000
		77,860	46,336	4,694	2,499										101,475

bandoned. § Blast now running Cold, have a Hot.

A Detailed Statement of all the COLD BLAST CHARCOAL FURNACES IN

COUNTY.	Sold by Sheriff, or failed.	No. Furnaces. In Blast	No. Furnaces. Out Blast.	Date of construction.	NAME OF WORKS.	SITUATION. POST OFFICE.	OWNERS.	LESSEES.
ams, . .			1	1830	Chesnut Grove,	Whitestown,	J. V. Boggs,	None.
air, . .		1		1824	Bald Eagle,	Warrior's Mark, Huntingd'n Co.	Lyon, Shorb & Co.	
do.		1		1819	Rebecca,	Martinsburg,	D. P. Schoenberger,	
do.		1		1846	Bloomfield,	Sarah,	"	
do.		1		1833	Sarah,	"	"	
Bedford, . .	1848 S		1	1841	Lemnos,	Hopewell,	Thos. King & Co.	
erks, . .		1		1759	Hopewell,	Douglasville,	Clement, Brooke & Co.	
do.		1		1816	Mossilm,	Mossilm,	N. V. R. Hunter,	F. S. Hunter.
do.		1		1793	Joanna,	Joanna,	Darling & Smith,	
do.		1		1827	Mount Penn,	Reading, 4 m.	John Schwartz,	
do.		1		1797	Mary Ann,	Long Swamp,	Hort. Trexler,	
do.		1		1791	Sally Ann,	New Jerusalem,	J. V. R. Hunter,	
do.			1	1835	Oley,	Oley,	Jacob S. Spang,	
do.	1842 S		1	before 1770	Old Oley,	Pricetown,	George Merkel,	
umberland, .	1846 S		1	1826	Mary Ann,	Shippensburg,	Carlisle Bank,	
do.	1846 S		1	1828	Augusta,	"	J. M. Haldeman,	
do.	1847 S		1	1815	Carlisle,	Carlisle,	Peter F. Ege,	
do.	1849 F		1	1794	Cumberland,	Dickinson,	Thomas C. Miller,	
do.	1847 S		1	1836	Big Pond,	Shippensburg,	Schoch, Sons & Co.	
olumbia, . .	1847 S	1		1815	Catawissa,	Maineville,	B. P. Frick,	
entre, . .	1843 S		1	1832	Martha,	Martha Furnace P. O.	Rowland Curtin & Sons,	
do.	1843 S	1		1818	Eagle,	Milesburg,	C. & J. Curtin,	
do.		1		1800	Logan,	Bellefonte,	Valentines & Thomas,	
do.	1850 F	1		1816	Rock,	Bellefonte, 5 m.	Samuel Edmiston,	
do.	1844 S		1	1828	Hannah,	Centre Line,	Lyon, Shorb & Co.	Campbell, Stevens
do.	1849 S		1	1835	Juliana,	Juliana,	John Adams,	
do.		1	1	1830	Howard,	Howard,	Irvin, Thomas & Co.	
linton, . .	1839 S		1	1834	Sugar Valley,	Loganville,	J. T. Hale,	
do.	1839 S		1	1831	Lamar,	Salona,	Solomon McCormick,	
hester, . .		1		1835	Isabella,	Rockville,	David Potts & Co.	
do.		1		1736	Warwick,	Pottstown,	David Potts, Jr.	
auphin, . .	1847 S	1		1849	Middletown,	Middletown,	Peters & Gamber,	Grubb & Cabean.
do.	1847 S	1		1833	"	"	"	"
ranklin, . .	1849 S	1		1800	Carrick,	Faussetsburg, 4 m.	N. Kelley,	Witherow & Walk
do.	1849 S		1	1830	Southampton,	Shippensburg, 3½,	Alfred Bujac,	
do.	1849 S		1	1835	Mary,	" 4,	"	
do.			1	1828	Franklin,	St. Thomas, 4,	B. Phreaner & Sons,	
do.			1	1825	Valley,	Louden, 2,	John Beaver,	Scheffler & Son.
do.			1	1835	Warren,	Sylvan,	Bowers' heirs,	
Huntingdon, .	1849 S		1	1846	Rebecca,	McElavey Fort P. O.	A. G. Curtin,	
do.		1		1813	Pennsylvania,	Baileysville,	Lyon, Shorb & Co.	
do.	1847 S	1		1833	Greenwood,	14 miles from Lewistown,	John A. Wright & Co.	
do.	1848 S		1	1846	Malinda,	Orbisonia,	Blair & Madden,	
do.		1		1829	Paradise,	Paradise Furnace,	H. Trexler & Co.	
do.	1849 S		1	1838	Jackson,	McElavey Fort,	Mitchell, Vance & Alexander,	
Lehigh, . .	1850 S		1	1800	Hampton,	Lionsville,	Seyfert, McManus & Co.	
ycoming, . .		1		1838	Heshbon,	Newberry,	Wm. McKinney,	
do.			1	1820	Pine Creek,	Jersey Shore, 4 m.	J. Vickers,	
ancaster, . .		1		1785	Mount Hope,	Mount Hope,	E. & B. Grubb,	
do.			1	1846	Lancaster,	Lancaster,	George Ford,	
ebanon, . .		1		1745	Cornwall,	Cornwall,	R. W. Coleman,	
do.		1		1745	Colebrooke,	Elizabethtown, Lancaster Co.	Wm. Coleman,	
do.			1	1837	Monroe,	Fredericksburg,	Jonathan Seidel,	Seidel & Thompso
Mifflin, . .			1	1830	Marion,	Perryville,	W. & T. Reed,	
Montgomery, .			1	1836	Green Lane,	Sumneytown,	Wm. Schall,	
Northumberland,	1848 S		1	1847	Paxinas,	Paxinas,	Taggert & Co.	
Perry, . .	1841 S		1	1833	Caroline,	Bailysburg,	James Bailey,	
do.			1	1830	Oak Grove,	Landisburg,	Thudium & Co.	
Schuylkill, .			1	1840	Jefferson,	Schuylkill Haven,	David Potts,	
	27	27	33					

tement of all the COLD BLAST CHARCOAL FURNACES

SITUATION. POST OFFICE.	OWNERS.	LESSE
testown,	J. V. Boggs,	None.
rior's Mark, Huntingd'n Co.	Lyon, Shorb & Co.	
insburg,	D. P. Schoenberger,	
h,	"	
	"	
well,	Thos. King & Co.	
lasville,	Clement, Brooke & Co.	
ilm,	N. V. R. Hunter,	F. S. Hunter.
ıa,	Darling & Smith,	
ng, 4 m.	John Schwartz,	
Swamp,	Hort. Trexler,	
Jerusalem,	J. V. R. Hunter,	
	Jacob S. Spang,	
town,	George Merkel,	
ensburg,	Carlisle Bank,	
"	J. M. Haldeman,	
ıle,	Peter F. Ege,	
nson,	Thomas C. Miller,	
ensburg,	Schoch, Sons & Co.	
ville,	B. P. Frick,	
ıa Furnace P. O.	Rowland Curtin & Sons,	
burg,	C. & J. Curtin,	
onte,	Valentines & Thomas,	
onte, 5 m.	Samuel Edmiston,	
e Line,	Lyon, Shorb & Co.	Campbell, Stev
n,	John Adams,	
rd,	Irvin, Thomas & Co.	
ıville,	J. T. Hale,	
h,	Solomon McCormick,	
ille,	David Potts & Co.	
own,	David Potts, Jr.	
etown,	Peters & Gamber,	Grubb & Cabe
"	"	"
etsburg, 4 m.	N. Kelley,	Witherow & W
ensburg, 3½,	Alfred Bujac,	
" 4,	"	
ıomas, 4,	B. Phreaner & Sons,	
n, 2,	John Beaver,	Scheffler & Son
h,	Bowers' heirs,	
ıvey Fort P. O.	A. G. Curtin,	
sville,	Lyon, Shorb & Co.	
es from Lewistown,	John A. Wright & Co.	
ınia,	Blair & Madden,	
se Furnace,	H. Trexler & Co.	
vey Fort,	Mitchell, Vance & Alexander,	
ille,	Seyfert, McManus & Co.	
erry,	Wm. McKinney,	
Shore, 4 m.	J. Vickers,	
Hope,	E. & B. Grubb,	
ster,	George Ford,	
all,	R. W. Coleman,	
ethtown, Lancaster Co.	Wm. Coleman,	
icksburg,	Jonathan Seidel,	Seidel & Thom
ille,	W. & T. Reed,	
ytown,	Wm. Schall,	
s,	Taggert & Co.	
ıburg,	James Bailey,	
burg,	Thudium & Co.	
kill Haven,	David Potts,	

...the year 1850.

URNACES IN EASTERN PENNSYLVANIA, in the year 1850.

LESSEES.	Kind of Ores used.	Largest Product	Actual make in 1849.	No. of men and boys employed	No. oxen, horses and mules employed.	BLAST.			STACK.		Kind of Power used.	Kind of Metal made.	Market for sales.	Capacity
						Cold.	Tuyeres.		Pressure.					
							No.	Diam.		Bosh feet.	Height. feet.				
		Tons.	Tons.											Tons.
None.	M.	500		56	35	cold	1			8	32	Water.			1,100
	H.	1,830	1,700	118	40	"	1	2½		8½	34	"	3	W.	1,830
	H.	1,500	1,300	60	50	"	1	"		8½	32	"	3	W.	1,500
	H.	1,350	1,000	75	32	"	1	"		8½	30	Steam.	3	W.	1,350
	H.	1,400	1,200	70	55	"	1	"		8½	32	Water.	3	W.	1,400
	½ F. & H.	400	291	74	30	"	1	2½		8½	30	Steam.	3	H. & W.	1,350
	M.	1,150	1,000	80	50	"	1		¾	6½	30	Water.	1	E.	1,150
F. S. Hunter.	H.	1,200	1,200	60	54	"	1	2		8.9	32	"	2, 3	"	1,350
	M.	1,050	1,050	50	30	"	1			7.6	31	"	2, 3	"	1,050
	M.	1,050	897	100	64	"	1	2⅛		8	31	"	2, 3	"	1,100
	M. & H.	1,000	800	59	35	"	1	2⅛		7	30	"	1, 3	"	1,000
	H.	850	750	60	40	"	1	2⅛		6	32	"	1, 2, 3	"	850
	M. & H.	800		60	35	"	1		¾	6½	28	"	1	"	800
	M. & H.	800				"	1			9	28	"	1	"	1,400
	H.	800		80	25	"	1	2½		8	32	"	3	"	1,100
	H.	800		80	25	"	1	2½		8	32	S.&W.	3	"	1,100
	H.	875		56	29	"	1	1¾		7½	25	Water.	2	"	1,000
	½ M. & H.	400	247	40	25	"	1	2		8½	30	"	2, 3	"	1,350
	F. & H.	871	871	75	50	"	1	2½		7½	30	"	3	"	1,000
	F.	750	500	53	50	"	1	3½		8½	32	"	1, 2	"	1,350
	H.	1,180		70	60	"	1	2½		8	32	"	3	"	1,180
	H.	800	800	80	45	"	2	2½		8	30	"	3	"	1,100
	H.	1,320	1,320	40	36	"	1	3	⅜	8	31	"	3	"	1,320
mpbell, Stevens & Co.	H.	700	700	35	36	"	1	1¾		7	28	"	3	"	900
	H.	1,261	800	100	40	"	1	2½		8½	33	"	3	W.	1,350
	H.	1,000	250	60	30	"	1	2½		8½	33	"	3	E.	1,350
	½ F. & H.	1,400	1,400	50	30	"	1	"		8½	33	"	3	"	1,400
	H.	400				"	1						1	"	800
	H.	750				"	1			8		"	2, 3	"	1,100
	M.	1,000	1,000	75	45	"	1	2½		6½	33	"	2, 3	"	1,000
ubb & Cabean.	M.	1,400	1,100	100	50	"	1	2½		7	33	"	2, 3	"	1,400
"	M.		470	70	42	"	1	2		6½	30	"	1	"	800
therow & Walker.	H.	400				"	1	2		8½	"	"	1	"	1,350
	H.	900		10	5	"	1	2½		7½	30	"	2, 3	H.	1,000
	H.	1,100	360	60	33	"	1	2		9½	30	"	1, 2, 3	E.	1,500
	H.	800	110	60	33	"	1	2		9	30	"	1, 2, 3	"	1,400
effler & Son.	H.	300	50	15	6	"	1	1½		9	30	"	2, 3	H.	1,400
	H.	227		35	6	"	1	1½		6	28	"	2, 3	H.	800
	F.	700	700	40	23	"	1	1¾		8	28	"	2	E.	1,100
	H.	2,309	1,792	120	50	"	1	2½		6½	27	"	3	"	800
	H.	1,069	729	100	67	"	1	2½ 3		8½	35	"	3	W.	2,310
	H.	350		30	20	"	1	2½		8½	32.4	"	2, 3	E.	1,200
	¼ F. & ¼ H.	700	560	35	24	"	2	2		6½	28	"	2, 3	"	800
	F.	350		30	18	"	1	2		7½	33	"	2, 3	"	1,000
	H.	650		46	26	"	1	2		6	20	"	3	"	800
	H.	550	400	30	30	"	1	2		9	32	"	2, 3	"	800
	F.	1,000		60	36	"	1	2		6.9	25	"	3	E. & H.	900
	M.	1,434	1,434	57	48	"	1	2		8	30	"	1, 2	H.	1,100
	H.	500	300	16	4	"	1	2		6½	27	"	1, 2	E.	1,434
	M.	1,405	750	60	46	"	2	2½		7½	33	Steam.	2, 3	"	1,000
	M.	1,600	1,400	60	60	"	1	2		7½	30	S.&W.	1	"	1,400
l & Thompson.	M.	500		40	25	"	1	2		9	30	Water.	1	"	1,600
	H.	1,800		80	35	"	1			7	30	"	1	"	900
	H.	450		50	18	"	1	2⅛				"	2, 3	"	1,800
	F.	300	300	35	12	"	2	2½		7.4	33	"	2, 3	"	900
	F.	750	166	40	10	"	1	2½		8	30	"	3	"	1,100
	F. & H.	800		50	12	"	1			9	25	Steam.	3	"	1,400
	M.	700		40	15	"	1			8		Water.	1	"	1,100
										6½		"			800
		52,231	29,697	3,185	1,830										69,524

in the year 1850.

COUNTY.	est Product.		Actual make in 1849.		No. men and boys employed.	No. oxen, horses and mules employed.	Market.*	Run out fires.
	ns.	Bars. Tons.	Blooms. Tons.	Bars. Tons.				
Bedford,	75	75			30	15	H. & E.	1

A Detailed Statement of all the BLOOMERY FORGES IN EASTERN PENNSYLVANIA, in the year 1850.

COUNTY.	Sold by Sheriff, or failed.	Date of construction.	NAME OF WORKS.	SITUATION. P. O.	OWNERS.	LESSEES.	Kind of Power employed.	No. Bloom'y fires.	No. Hammers.	Largest Product. Tons.	Actual make 1849.	Form in which Iron leaves the Works.	Men and boys employed.	Horses, mules and oxen employed.	MARKET.
Carbon,		1830	Maria,	Lehighton,	T. M. Smith and Est. of Richards,	None.	Water.	2	1	10	10	Bars.	6	2	Home.
"		1848	Pine Run,	do. 5	J. & D. Lowrey,	"	"	1	1	65	65	"	25	12	"
"		1820	Ashland,	Lehigh Gap, 7	J. J. Albright,	"	"	2	1	80	80	"	12	8	"
"		1843	Anthony's,	do. 7½	N. Anthony,	"	"	2	1	40	40	"	12	4	"
Monroe,		1829	Analomink,	Stroudsburg,	John Jordan, Jr.,	Jas. Bell, Jr.	"	3	2	280	100	"	30	12	"
Northampton,	1847 F	1805	Jacobsburg,	Jacobsburg,	A. Benade,	C. E. Benade.	"	2	1	70	40	"	12	2	"
								12	7	545	335		97	40	

These six works all use the rich Magnetic Ores from New Jersey, and consume about 3 tons of ore and 15 cords of wood to the ton of bars produced. The average annual capacity is 50 tons per fire, which, for the 12 fires in the State, would give 600 tons of bars, consuming 9000 cords of wood, and 1800 tons of ore.

A Detailed Statement of the FORGES IN EASTERN PENNSYLVANIA, in the year 1850, not properly belonging to either of the other classes.

COUNTY.	Sold by Sheriff, or failed.	Date of construction.	NAME OF WORKS.	SITUATION. P. O.	OWNERS.	No. Puddling Fur.	No. Heating Fur.	No. forge fires.	CONSUMED. Bitum's Coal. Tons.	Anthra'e Coal. Tons.	Wood. Cords.	Pig. Tons.	Bloom. Tons.	Scrap. Tons.	Largest Product Tons.	No Furnaces running. 1850. Puddling	Heating.	Men and boys employed.	Horses, mules and oxen employed.	Description of Iron made.	Kind of Power employ'd	Actual make 1849.	Capacity.
Berks,	1848 S	1846	Reading,	Reading,	A. Taylor,		2			1000			450		400			14	3	Axles.	Steam.		600
Cumberland,	1849 S	1848	Holley,	Papertown,	F. & M. Bank, Philada.,	2	1			800		1000			10			25	6	Blooms.	"		800
Philadelphia,		1849	Kensington,	Kensington,	J. Rowland & Co.		1		600				500	100			1	7	1	Steel plates.	"		1000
"		1850	Oxford,	Frankford,	W. & H. Rowland,			3			1500			1000				13	2	Saw plates.	"		600
						2	4	3	600	1800	1500	1000	950	1100	410		1	59	12				3000

A Detailed Statement of all the ROLLING MILLS IN EAS

COUNTY.	Sold by Sheriff, or failed.	Date of construction.	NAME OF WORKS.	SITUATION. POST OFFICE.	OWNERS.	No. Puddling Fur.	No. Heating Fur.	No. Train Rolls.	No. Nail Machines.	CONSU Bituminous Coal. Bush.	Anthracite Coal. Tons.
rks,* . .		1845	Bertolet's,	Reading,	M. A. & S. Bertolet & Co.	4	4	2			4,000
do.†		1836	Reading,	"	Reading Iron and Nail Co.	12	3	3	30		14,000
do.		1848	Birdsboro,	Birdsboro,	E. & G. Brooke,	4	2	1	16		3,000
do.		1846	Gibraltar,	Robeson Township,	H. A. Seyfert, McIlvaine & Co.		2	1			900
do.		1845	Pine,	Douglasville,	Joseph Bailey,		2	1		25,000	
ter, . .		1839	Portage,	Duncanville,	Royer, McNeal & Co.	4	4	3	18	115,000	
ntre, . .		1825	Bellefonte,	Bellefonte,	Valentines & Thomas,	1	2	3		25,000	
do.		1831	Milesburg,	Milesburg,	Irvin, McCoy & Co.	1	2	1		37,500	
do.	1849 S	1846	Hecla,	Zion,	Boyd & Cummings,	2	1	1		20,000	
do.	1843 F	1829	Eagle,	Milesburg,	C. & J. Curtin,	1	1	1		17,500	
do.		1840	Howard,	Howard,	Irvin, Thomas & Co.	3	1	1		30,000	
hester, . .		1838	Triadelphia,	Coatesville,	James Yearsley & Bro.	1	4	2		30,000	
do.		1844	Pine Grove,	Oakhill,	Enos Pennock,		2	1		12,000	
do.	1848 S	1845	Pleasant Garden,	N. London ⋈ Roads,	Ellis P. Irwin,	1	2	1		18,000	
do.		1849	Summerfield,	Pottstown,	Christman & Bro.		2	1			
do.		1830	Chester Co.	Phœnixville,	Jaudons & Mason,	7	2	1	40		4,000
do.		1836	W. Brandywine,	Coatesville,	S. Hatfield,		4	2		30,000	
do.	{ first built 1790 rebuilt 1835		Phœnix,	Phœnixville,	Reeves, Buck & Co.	15	4	4			6,988
do.		1846	Phœnix Rail Mill,	"	"	25	6	2			20,656
do.		1837	Hibernia,	Wagontown,	Charles Brooke,		2	1		14,000	20
do.		1810	Brandywine,	Coatesville,	Mrs. R. W. Lukens,‡		2	1		21,000	50
do.		1825	Laurel,	"	Hugh E. Steel,§	1	2	1		20,000	50
do.		1847	Thorndale,	Downingtown,	J. & J. Forsythe & Sons,	2	4	1		35,000	
do.	1849 F	1795	Rokeby,	Coatesville,	Mrs. A. Fisler,		3	1		50,000	50
do.		1840	Caln,	"	Pennock's Heirs,	2	3	2		50,000	50
olumbia, . .		1846	Montour,	Danville,	Montour Iron Co.	30	8	2			19,466
do.		1847	Rough and Ready,	"	Hancock & Foley,	4	2	2		2,000	3,000
do.	1848 S	1845	Danville,	"	S. P. Case, (Davis, lessee,)	3		2			1,081
umberland,‖ .		1831	Fairview,	Harrisburg,	J. Pratt & Son,	5	3	3	36	90,000	
uphin, . .	1842 S	1836	Harrisburg,	Harrisburg,	J. Pratt & Son,		2	1		13,000	500
laware, . .		1808	Franklin,	Chester,	J. G. Johnson,		1	1			300
anklin, . .	1842 F	1810	Montalto,	Montalto,	H. & H. Hughes,		4	2		5,000	
ntingdon, .	1850 S	1847	Juniata,	Shaver's Creek,	Ed. F. Schoenberger,	1	3	1		15,000	
do.		1838	"	Alexandria,	S. Hatfield & Son,	2	3	2		55,000	
ncaster, . .		1848	Safe Harbor,	Safe Harbor,	Reeves, Abbott & Co.	24	6	2		175,000	5,996
do.		1828	Colemanville,	Lancaster,	R. & G. D. Coleman,		4	2	12		1,000
zerne, . .	1848 S	1842	Wyoming,	Wilkesbarre,	T. T. Paine,	12	10	5	20		6,500
do.		1844	Lackawanna,	Scrantonia,	Scranton & Platt,	24	7	4	22		14,000
coming, . .		1842	Heshbon,	Newberry,	Wm. McKinney,	1	1	1		17,500	
do.		1842	Crescent,	Trout Run,	C. G. Heilman & Bros.	2	1	2	7	30,000	
ontgomery,¶ .		1846	Pottsgrove,	Pottstown,	Henry Potts & Co.	3	4	2			3,000
do.		1846	Norristown,	Norristown,	Moore & Hooven,	10	3	3			6,100
do.		1830	Conshohocken,	Conshohocken,	Jas. Wood & Sons,	2	2	2			1,200
do.		1790	Cheltenham,	Philadelphia,	Mrs. H. M. Rowland,**		3	1		25,000	
rthampton, .		1837	Lehigh,	S. Easton,	Rodenbaugh, Stewart & Co.		4	3	6		1,500
iladelphia, .		1845	Kensington,	Kensington,	Jas. Rowland & Co.	10	3	3			5,000
do.		1840	"	"	Jos. Jobson & Co.		2	2			500
do.		1845	Penn,	"	Robbins & Verree,		4	2			1,250
do.		1846	Treaty,	"	Leiberts & Wainwright,	5	3	2			3,000
do.	1848 F	1846	Fairmount,	Spring Garden,	Thomas & Ogden,	7	2	3			7,000
do.		1848	Fountain Green,	"	Jas. S. Spencer,	2	2	2		7,000	300
do.	1842 S	1820	Flat Rock,	Manayunk,	M. B. Buckley & Son,	1	2	2		12,000	750
do.		1842	Oxford,	Frankford,	W. & H. Rowland,		2	1		10,000	1,000
rry,†† . .		1838	Duncannon,	Duncannon,	Fisher, Morgan & Co.	10	5	5	45	120,000	3,000
ioga, . .		Unfinished.	Blossburg,	Blossburg,	J. H. Gulick,	1	1	1			
huylkill,‡‡ .	1844 S	1839	Franklin,	Port Clinton,	John Raush,	2	1	1			1,500
	12					247	164	106	252	1,126,500	140,707

Schall & Dewees, Norristown, 24

Total No. Nail Machines in Eastern Pennsylvania, 276

* No bars made last year nor this year. † No bars made for market since June, 1848, now making nails and gas tubes only.
¶ Made no bar iron since January, 1848. ** Rowland & Hunt, lessees. †† Have sold no bars or

Statement of all the ROLLING MILLS IN EASTE

OWNERS.	No. Puddling Fur.	No. Heating Fur.	No. Train Rolls.	No. Nail Machines.	CONSUMED. Bituminous Coal. Bush.	Anthracite Coal. Tons.	Pig. Tons.
. A. & S. Bertolet & Co.	4	4	2			4,000	1,800
eading Iron and Nail Co.	12	3	3	30		14,000	5,000
. & G. Brooke,	4	2	1	16		3,000	1,200
. A. Seyfert, McIlvaine & Co.		2	1			900	
oseph Bailey,		2	1		25,000		
oyer, McNeal & Co.	4	4	3	18	115,000		1,700
alentines & Thomas,	1	2	3		25,000		500
vin, McCoy & Co.	1	2	1		37,500		500
oyd & Cummings,	2	1	1		20,000		500
. & J. Curtin,	1	1	1		17,500		500
vin, Thomas & Co.	3	1	1		30,000		1,250
mes Yearsley & Bro.	1	4	2		30,000		150
nos Pennock,		2	1		12,000		
llis P. Irwin,	1	2	1		18,000		
hristman & Bro.		2	1				
audons & Mason,	7	2	1	40		4,000	2,200
. Hatfield,		4	2		30,000		
eeves, Buck & Co.	15	4	4			6,988	5,785
"	25	6	2			20,656	12,105
harles Brooke,		2	1		14,000	20	
Mrs. R. W. Lukens,‡		2	1		21,000	50	
Hugh E. Steel,§	1	2	1		20,000	50	
. & J. Forsythe & Sons,	2	4	1		35,000		200
Mrs. A. Fisler,		3	1		50,000	50	
ennock's Heirs,	2	3	2		50,000	50	800
Montour Iron Co.	30	8	2			19,466	9,807
Hancock & Foley,	4	2	2		2,000	3,000	1,050
. P. Case, (Davis, lessee,)	3		2			1,081	803
. Pratt & Son,	5	3	3	36	90,000		1,800
. Pratt & Son,		2	1		13,000	500	
. G. Johnson,		1	1			300	
. & H. Hughes,		4	2		5,000		
d. F. Schoenberger,	1	3	1		15,000		200
. Hatfield & Son,	2	3	2		55,000		660
eeves, Abbott & Co.	24	6	2		175,000	5,996	7,805
. & G. D. Coleman,		4	2	12		1,000	
. T. Paine,	12	10	5	20		6,500	3,800
cranton & Platt,	24	7	4	22		14,000	10,000
Wm. McKinney,	1	1	1		17,500		125
. G. Heilman & Bros.	2	1	2	7	30,000		350
Henry Potts & Co.	3	4	2			3,000	400
Moore & Hooven,	10	3	3			6,100	3,250
as. Wood & Sons,	2	2	2			1,200	600
Mrs. H. M. Rowland,**		3	1		25,000		
odenbaugh, Stewart & Co.		4	3	6		1,500	
as. Rowland & Co.	10	3	3			5,000	2,500
os. Jobson & Co.		2	2			500	
obbins & Verree,		4	2			1,250	
eiberts & Wainwright,	5	3	2			3,000	1,750
Thomas & Ogden,	7	2	3			7,000	3,416
as. S. Spencer,	2	2	2		7,000	300	350
M. B. Buckley & Son,	1	2	2		12,000	750	225
W. & H. Rowland,		2	1		10,000	1,000	
Fisher, Morgan & Co.	10	5	5	45	120,000	3,000	4,000
. H. Gulick,	1	1	1				
ohn Raush,	2	1	1			1,500	440
	247	164	106	252	1,126,500	140,707	87,521
Schall & Dewees, Norristown,				24			
Total No. Nail Machines in Eastern Pennsylvania,				276			

r market since June, 1848, now making nails and gas tubes only. ‡ Gib
. ** Rowland & Hunt, lessees. †† Have sold no bars or rods in t

TERN PENNSYLVANIA, in the year 1850.

MED. Pig. Tons.	Bloom. Tons.	Scrap Tons.	Largest Product. Tons.	No Furnaces running, 1850. Puddling	Heating.	No. of men and boys employed	No. oxen, horses and mules employed.	Description of Iron made.	Kind of Power used.	Actual make, 1849. Tons.	No. run out fires.	Market.
1,800	150	50	1,500	2	2	60	2	Sheets, Bars, Rods,	Steam.	500		E.
5,000	200	100	4,275	6	3	155	3	Bar, Rods, Nails, Band and Hoop,	"	2,100		"
1,200	100	100	1,000	4	1	100	4	Nails,	Water.	1,000		"
	600		600		1	10	4	Boiler,	"	400		"
	850		850		2	18	6	"	"	850		"
1,700	100	50	1,500	4	2	50	18	Nails, Plate, Bar and Rod,	Steam.	1,000	1	E. & W.
500	600		1,000	1	1	16	18	Slit Rods, Bars and Axles,	Water	1,000		E.
500		20	1,000	1	1	30	26	Slit Rods, Bar, Wire-Billets,	"	800		"
500			400			16	12	Plate and Sheet,	Steam.			"
500			750	1	1	10	6	Wire-Billet and Shovel Plate,	Water.	546		"
1,250			1,000	3	1	18	3	Slit Rods and Bars,	"	400		"
150	450	20	550	1	2	20	4	Boiler and Flue Iron,	"	550		"
	400		400		1	9	4	" "	"	340		"
	600		600			16	4	" "	"			"
						10	10	" "	S.&W.			"
2,200	100	100	2,000	7	2	70	2	Nails,	Water.	1,800		"
	1,000		1,000		4	30	14	Boiler and Flue,	"	1,000		"
5,785			5,251			130	15	Bar and Sheet,	S.&W.			"
12,105			9,442	13	3	307		R. R. Iron,	Steam.	5,463		"
	400		450		1	16		Boiler and Flue,	Water.			"
	944		944		2	17	4	" "	"	944		"
	854		854		2	18	10	" "	"	854		"
200	725		725	1	4	32		" "	Steam.	725		"
	875		875			22	10	" "	Water.	150		"
800	800	Angle 600 Boiler 800				42	4	" and Rod,	"			"
9,807			7,357	30	8	250	8	Rails,	Steam.	1,943		"
1,050		50	955	4	2	62	2	Bar, Rod,	"	955		"
803			725			28	1	Pud. Bar,	"			H.
1,800	50		1,500	5	3	75	30	Bar, Rod, Nails,	Water.	1,500		E. & H.
	400	25	400		2	14	1	Boiler,	Steam.	400		E.
	10		220		1	7	5	Spring Steel, 210, Sheet Iron, 10,	Water.	220		"
		40	340		4	150	30	Bar and Rods,	"	340	1	H.
200			150			19	1	Boiler, Sheet,	"	100	1	W.
660			1,000	2	3	45	22	Boiler, Sheet, Bar,	"	1,000	1	E. H. W.
7,805			5,567	16	4	375	20	Rails,	Steam.	5,567		E.
								Boiler and Flue,		237		"
	1,059		1,500		4	50	21	Bar and Slit Rod,	Water.	871		E. & H.
								Steel,		106		E.
3,800			3,000			250	10	Rails, Bar, Nails,	Steam.			"
10,000			7,000	16	6	250	75	Rails,	S.&W.	6,000		"
125	300		400	1	1	7	2	Bars,	Water.	350		E. & H.
350		20	300	1	1	20	6	Bars and Nails,	"	300		H.
400	863		1,500	1	2	30	14	Boiler and Rods,	Steam.	Boiler, 863		E.
										1,775		"
3,250	50	150	2,775	10	3	125	3	Bars, Band and Nail Plates,	"	1,000		"
600	200		350	1	1	22	1	Imitation Russian Sheet,	Water.	279		"
	600		600		1	25	14	Boiler and Flue,	"	300		"
	1,000	50	Wire 1,050		2	65		Wire,	"	900		"
2,500	250	250	2,500	10	3	75	4	Bars, Rods,	Steam.	2,500		"
	1,300		1,200		1	8	2	Saw Plates, Spring Steel,	"	600		"
	200	1,800	2,517		2	28	4	Bars, Boiler, Slit Rod, Spring Steel,	"	1,685		"
1,750			1,400			75	2	Bars, Rails,	"			"
3,416	787	180	3,876			105	4	Bar, Rod, Band,	"			"
350		50	300			20	6	Rod, Spikes,	"	300		"
225	450		600	1	1	18	4	Boiler and Flue,	Water.	600		"
	400	400	700		2	10	4	Spring and Saw Steel,	Steam.	600		"
4,000	50	300	3,000	10	3	200	25	Bar, Plate, Rod,	Water.	2,975		E. & H.
								Bars,	Steam.			H.
440		150	450	1	1	18	7	Bars,	Water.	50		E. & H.
87,521	17,717	3,905	91,598	153	97	3,648	511			54,738	4	

‡ Gibbons & Huston, lessees.
rods in the city since November, 1848.

§ Steel & Worth, lessees.
‡‡ No bars made for city market since 1847.

‖ Have sold no bars in the city since 1847.

A DetaiNNSYLVANIA in the year 1850.

COUNTY	No. horses and mules employed.	No. Tuyeres.	STACK. Bosh. feet.	STACK. Height. feet.	Kind of Power used.	Kind of Metal made. No.	Capacity. Tons.

STATEMENT, showing the number and condition of each sort of IRON WORKS, and the capital invested in the Land and Buildings in each County in WESTERN PENNSYLVANIA, in the year 1850.

FURNACES.

COUNTY.	RAW BITUMINOUS COAL AND HOT BLAST					COKE AND HOT BLAST.					CHARCOAL AND HOT BLAST.					CHARCOAL AND COLD BLAST.					FORGES.			ROLLING MILLS.			TOT	
	S.* F.	In.	Out.	Total.	Investment.	S.* F.	In.	Out.	Total.	Investment.	S.* F.	In.	Out.	Total.	Investment.	S.* F.	In.	Out.	Total.	Investment.	S.* F.	Total No.	Investment.	S.* F.	Total No.	Investment.	S.* F.	Total No.
1. Allegheny,																									16	1,837,000		16
2. Armstrong,						4	0	4	4	800,000	1	1		1	38,000	5	7	4	11	374,560				1	2	175,000	11	18
3. Beaver,																												
4. Butler,																1	4	2	6	190,000							1	6
5. Cambria,											1	1	1	2	77,000		3	1	4	145,000							1	6
6. Clarion,											1	1		1	40,000	6	22	6	28	1,177,166		1	4,000				7	30
7. Crawford,																												
8. Elk,																												
9. Erie,																		1	1	12,000								1
10. Fayette,																4	3	2	5	151,500				1	2	115,000	5	7
11. Forest,																												
12. Greene,																												
13. Indiana,											1	2		2	85,000	2		2	2	48,000	1	1	5,000				4	5
14. Jefferson,																												
15. Lawrence,												1		1	40,000			1	1	20,000					2	250,000		4
16. McKean,																												
17. Mercer,	3	3	4	7	223,000						3	1	5	6	180,000	1		3	3	68,000							7	16
18. Somerset,											1		1	1	20,000	2		2	2	35,000	1	1	5,000				4	4
19. Venango,											1	1	1	2	40,000	11	8	10	18	487,650					1	48,500	12	21
20. Warren,																												
21. Washington,																												
22. Westmoreland,											1	2		2	91,000	2	2	2	4	105,000							3	6
	3	3	4	7	223,000	4	0	4	4	800,000	10	10	8	18	611,000	34	49	36	85	2,813,876	2	3	14,000	2	23	2,425,500	55	140

22 Counties—13 Counties having Iron Works.

* Sold by Sheriff or failed since 1840.

A Detai NNSYLVANIA in the year 1850.

COUNTY	No. horses and mules employed.	No. Tuyeres.	STACK. Bosh. feet.	STACK. Height. feet.	Kind of Power used.	Kind of Metal made. No.	Capacity. Tons.
Armstrong,	48	1	8	30	Steam.	3	1,100
"	20	2	8	32	S.&W.	3	1,100
"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

A Detailed Statement of all the CHARCOAL HOT-BLAST FURNACES IN WESTERN PENNSYLVANIA in the yea

COUNTY.		Date of Sheriff's sale or failure.	No. furnaces. In.	No. furnaces. Out.	Date of construction	NAME OF WORKS.	SITUATION. POST OFFICE.	OWNERS.	Kind of ore used.	Largest Product. Tons.	Actual make 1849. Tons.	No. men and boys employed.	No. horses and mules employed	No. tuyeres	Diam. Bosh. feet.	Height feet.	Kind of Power used.	Kind metal and No.	Capacit Tons.
Armstrong,	1	1844 S	1		1839	Buffalo,	Worthington,	P. Graff & Co.,	C.	1,800	1,800	80	50	2	9	32	W.&S.	3	1,80
Cambria,	2		1		1846	Ben's Creek,	Johnstown,	G. S. King & Co.,	H.	1,080	1,080	90	35	2	9	30	Water,	2, 3	1,80
"		1848 S		1	1846	Eliza,	Ebensburg,	Ritter & Irvin,	H.	1,000		90	45	2	9	30	"	3	1,80
Clarion,	1	1842 S	1		1833	Lucinda,	Lucinda,	Reynolds & Buchanan,	C.	1,429	1,280	80	45	1	7, 10	30	"	1, 2	1,45
Indiana,	2	1845 S	1		1842	Indiana,	Armagh,	Elias Baker,	H.	1,100	900	80	36	2	9	30	"	2, 3	1,80
"			1		1846	Blacklick,	"	Schoenberger, King & Co.,	"	1,000	756	80	46	1	8	30	"	2, 3	1,40
Lawrence,	1		1		1848	Wilmington,	Wilmington,	Cassallo Iron Co.,	C.	1,400	1,400	100	50	3	10	34	Steam,	2, 3	2,00
Mercer,	6	1848 F		1	1846	Hamburg,	Delaware Grove,	John Warden,	"	800	800	75	30	2	10	38	"	1, 2	2,00
"		1848 F		1	1848	Harry of the West,	Georgetown,	Dr. Wm. Irvin,	"	500	500	80	50	3	9	40	"	2, 3	1,80
"			1		1846	Mineral Ridge,	"	Ward & Co.,	"	900	400	75	33	2	8, 6	34	"	2, 3	1,60
"				1	1846	Sandy No. 2,	Pryon,	Gen. C. M. Read,	"	600		50	30	2	8		Water,	3	1,40
"				1	1838	" " 1,	"	"	"	500		50	30	2	7		"	3	1,00
"		1849 S		1	1846	Mazeppa,	Mercer,	J. P. Garrett & Co.,	"	800		60	35	2	7, 6	33	Steam,	2, 3	1,00
Somerset,	1	1850 S		1	1812	Shade,	Stoystown,	Shryock, Bingham & Co.,	C. H.	900	750	80	43	1	8	30	Water,	2, 3	1,40
Venango,	2	1847 S		1	1845	Orleans,	Franklin,	Reymond & Grey,	C.	700	700	50	45	3	9	27, 6	"	2, 3	1,80
"			1		1832	Rockland,	Rockland,	Dempsey & Wick,	"	550	200	50	40	1	8, 6	28	Steam,	2	1,60
Westmoreland,	2		1		1847	Conemaugh,	Armagh,	McGill & Foster,	H.	800	600	60	30	2	9	33	"	3	1,80
"		1848 S	1		1846	Laurel Hill,	West Fairfield,	Hoover & McCallister,	"	800	800	80	40	2	9	33	Water,	3	1,80
		10	10	8						16,659	11,966	1,310	713						29,2

Total number furnaces 18

12,000

A Detai NNSYLVANIA in the year 1850.

COUNTY	No. horses and mules employed.	No. Tuyeres.	STACK. Bosh. feet.	STACK. Height. feet.	Kind of Power used.	Kind of Metal made. No.	Capacity. Tons.
Armstrong,	48	1	8	30	Steam.	3	1,100
"	20	2	8	32	S.&W.	3	1,100
"	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NNSYLVANIA in the year 1850.

Diam. Bosh. feet.	Height feet.	Kind of Power used.	Kind metal and No.	Capacity Tons.	Remarks.
9	32	W.&S.	3	1,800	
9	30	Water,	2, 3	1,800	
9	30	"	3	1,800	
7, 10	30	"	1, 2	1,450	Leased by Reynolds & Evans.
9	30	"	2, 3	1,800	Bosh 7 feet until 1847.
8	30	"	2, 3	1,400	
10	34	Steam,	2, 3	2,000	
10	38	"	1, 2	2,000	
9	40	"	2, 3	1,800	Leased by Whitaker & Watson.
8, 6	34	"	2, 3	1,600	
8		Water,	3	1,400	
7		"	3	1,000	
7, 6	33	Steam,	2, 3	1,000	
8	30	Water,	2, 3	1,400	Abandoned 1828, rebuilt 1846.
9	27, 6	"	2, 3	1,800	
8, 6	28	Steam,	2	1,600	Leased by J. Dempsey.
9	33	"	3	1,800	
9	33	Water,	3	1,800	
				29,230	

12,000

Detailed Statement of all the CHARCOAL FORGES IN WESTERN PENNSYLVANIA in the year 1850.

COUNTY.	Date of Sheriff's sale or failure.	Kind of power employed.	Date of construction.	NAME OF WORKS.	SITUATION. P. O.	OWNERS.	No. forge fires	No. hammers.	Largest Product.	Actual make 1849		Men and boys employed	Horses, mules and oxen employed.	Market.	No. run out. Fires.
									Tons.	Bars.	Blooms.				
Clarion,		Water,	1833	Shippenville,	Shippenville,	Shippen & Black,	2	1	150	50		16	4	Home,	1
Indiana,	1845 S	"	1841	Indiana,	Armagh,	Elias Baker,	2	1	200	20	100	18	6	"	1
Somerset,	1850 S	"	1826	Shade,	Stoystown,	Shryock, Bingham & Co.,	1	1	30	30		8	3	"	
	2		3				5	3	380	100	100	42	13		2

[illegible],	7
"	1.5
Lawrence,	2.5
"	2.6
Venango,	1.2
Total	72,1

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A Detailed Statement of all the ROLLING MILLS IN WESTERN PENNSYLVANIA in the year

COUNTY.	Date of Sheriff's sale or failure.	Date of construction.	NAME OF WORKS.	SITUATION. POST OFFICE.	OWNERS.	Number puddling Fur.	Number Heating Fur.	No. Trains. Rolls.	No. Nail Machines.	CONSUMED. Bituminous Coal. Bush.	Wood Cords.	Pig. Tons.	Bloom. Tons.	Scrap Tons.	Largest Product. Tons.	No. Furnaces running, 1850. Puddling	Heating.	Men and boys employed.	Horses, mules and oxen employed.	No. and kind of power employed.	Actual make 1849 Tons
Alleghany,		1836	Pittsburg,	Pittsburg,	Lorentz, Sterling & Co.,	14	6	5	25	480,000	500	6,000	500	500	5,500	14	6	250	10	Steam.	5,50
"		1824	Kensington,	"	Carothers, Miller & Co.,	11	5	5	14	360,000		5,000	500	200	4,500	11	5	160	10	"	4,50
"		1835	Wayne,	"	Bailey, Brown & Co.,	11	6	4	16	300,000		4,500	300	100	4,000	11	6	150	10	"	2,50
"		1845	Lippincott,	"	Graff, Lindsay & Co.,	9	7	4	14	300,000		4,700	250	150	4,000	9	7	150	4	"	4,00
"		1825	Sligo,	"	Lyon, Shorb & Co.,	6	9	4	13	320,000		2,650	3,870	300	5,432	6	7	156	3	"	4,21
"		1823	Juniata,	"	G. & J. H. Schoenberger,	14	12	5	50	410,000		5,000	1,000	1,000	5,500	14	10	295	18	"	4,90
"		1828	Ætna,	"	Spang & Co.,	11	8	4	25	300,000		4,500	500	200	4,100	10	5	150	24	"	3,00
"		1840	Hecla,	"	Wood & McKnight,	11	5	3	15	300,000		5,090	100		4,000	11	5	150	26	"	3,50
"		1849	Eagle,	"	Jas. Wood & Co.,	10	5	4	31	200,000		2,800			2,100	10	5	108	4	"	2,10
"		1846	Clinton,	"	Cuddy, Jones & Co.,	10	6	4	11	177,300		2,566	60		2,900	10	6	102	6	"	2,02
"		1828	Juniata,	Alleghany City,	Semple, Bissell & Co.,	9	4	4	13	300,000		4,000	500	300	3,700	8	4	125	6	"	3,00
"		1845	Vesuvius,	Pittsburg,	Lewis, Dalzell & Co.,	9	6	4	19	260,000		3,000	50	50	2,250	8	5	120	8	"	2,00
"		1849	Pennsylvania,	"	Everson, Preston & Co.,	2	3	2		75,000	400	50	50	100	150	2	3	35	4	"	15
"		1849	Sheffield,	"	Singer, Hartman & Co.,	2	6	2		150,000		600	1,200	200	1,800	2	6	80	3	"	1,80
"		1844	Duquesne,	"	Coleman, Hailman & Co.,		4	4		120,000			1,000	1,200	1,800		4	80	4	"	1,80
"		1845	Pittsburg Steel,	"	Jones & Quigg,		3	1		100,000			900	450	1,200		2	50	2	"	1,20
Armstrong,	1844 S	1841	Brady's Bend,	Brady's Bend,	M. P. Sawyer and others,	26	10	2		672,000		9,000			7,200	20	4	200	20	"	
"		1848	Kittanning,	Kittanning,	Brown, Phillips & Co.,	10	5	4	12	360,000		3,300			2,500	8	5	150	5	"	2,50
Fayette,		1834	Fairchance,	Uniontown,	F. H. Oliphant & Son,	2	3	3	6	100,000		900		40	700	2	3	60	12	"	70
"	1847 S	1842	Brownsville,	Brownsville,	E. Hughes, lessee,	4	4	3	10	150,000		2,000	50	50	1,500	4	3	75	10	"	6
Lawrence,		1842	Cossallo,	New Castle,	Cossallo Iron Co.,	8	4	3	25	150,000		3,000		200	2,500	8	4	130	200	"	1,70
"		1847	Orizaba,	"	Peebles & Co.,	4	4	3	21	160,000		3,200		100	2,600	8	4	130	200	"	1,00
Venango,		1844	Franklin,	Franklin,	H. Coulter & Co.,	4	2	3	10	120,000		1,500		60	1,200	4	3	104	12	Water.	90
	2					187	128	80	330	5,864,300	900	73,266	10,830	5,200	72,132	180	112	3,010	601		53,4

Total No. Mills, 23

ailed Statement of all the ROLLING MILLS

WNERS.	Number puddling Fur.	Number Heating Fur.	No. Trains. Rolls.	No. Nail Machines.	CON	
					Bituminous Coal. Bush.	Wood Cords.
erling & Co.,	14	6	5	25	480,000	500
Miller & Co.,	11	5	5	14	360,000	
wn & Co.,	11	6	4	16	300,000	
say & Co.,	9	7	4	14	300,000	
& Co.,	6	9	4	13	320,000	
Schoenberger,	14	12	5	50	410,000	
o.,	11	8	4	25	300,000	
cKnight,	11	5	3	15	300,000	
& Co.,	10	5	4	31	200,000	
es & Co.,	10	6	4	11	177,300	
ssell & Co.,	9	4	4	13	300,000	
zell & Co.,	9	6	4	19	260,000	
reston & Co.,	2	3	2		75,000	400
rtman & Co.,	2	6	2		150,000	
Hailman & Co.,		4	4		120,000	
igg,		3	1		100,000	
ver and others,	26	10	2		672,000	
illips & Co.,	10	5	4	12	360,000	
hant & Son,	2	3	3	6	100,000	
lessee,	4	4	3	10	150,000	
on Co.,	8	4	3	25	150,000	
Co.,	4	4	3	21	160,000	
& Co.,	4	2	3	10	120,000	
	187	128	80	330	5,864,300	900

MILLS IN WESTERN PENNSYLVANIA in the year 1850.

CONSUMED.					Largest Product.	No. Furnaces running, 1850.		Men and boys employed.	Horses, mules and oxen employed.	No. and kind of power employed.	Actual make 1849.	No. run out Fires.	No. Forge fires.	Description of Iron made.	Remarks.
inous l. h.	Wood Cords.	Pig. Tons.	Bloom. Tons.	Scrap Tons.	Tons.	Puddling	Heating.				Tons.				
000	500	6,000	500	500	5,500	14	6	250	10	Steam.	5,500	1	1		
000		5,000	500	200	4,500	11	5	160	10	"	4,500	1			
000		4,500	300	100	4,000	11	6	150	10	"	2,500	1			
000		4,700	250	150	4,000	9	7	150	4	"	4,000	1			
000		2,650	3,870	300	5,432	6	7	156	3	"	4,241	1			Enlarged 1837.
000		5,000	1,000	1,000	5,500	14	10	295	18	"	4,900	1		Bar, Rod, Hoop, Sheet, Boiler,	" 1845.
000		4,500	500	200	4,100	10	5	150	24	"	3,000	1		Nails, Spikes.	" 1838.
000		5,000	100		4,000	11	5	150	26	"	3,500	1			
000		2,800			2,100	10	5	108	4	"	2,100	1			
300		2,566	60		2,900	10	6	102	6	"	2,029	1			
000		4,000	500	300	3,700	8	4	125	6	"	3,000	1			
000		3,000	50	50	2,250	8	5	120	8	"	2,000	1			Running half time.
000	400	50	50	100	150	2	3	35	4	"	150		1	Rods Shafts, Anchors, Axles.	
000		600	1,200	200	1,800	2	6	80	3	"	1,800			"	
000			1,000	1,200	1,800		4	80	4	"	1,800			Boiler& Sheet Iron&Sheet Steel,	
000			900	450	1,200		2	50	2	"	1,200			Bar and Sheet Steel and Iron.	
000		9,000			7,200	20	4	200	20	"		1		Rails.	Running half time.
000		3,300			2,500	8	5	150	5	"	2,500	1	1		
000		900		40	700	2	3	60	12	"	700	1	2		
000		2,000	50	50	1,500	4	3	75	10	"	600	1		Bar, Rod, Sheet, Plate, Hoops	Running half time.
000		3,000		200	2,500	8	4	130	200	"	1,700	2		and Nails.	
000		3,200		100	2,600	8	4	130	200	"	1,000	1			
000		1,500		60	1,200	4	3	104	12	Water.	900				
,300	900	73,266	10,830	5,200	72,132	180	112	3,010	601		53,620	19	5		